



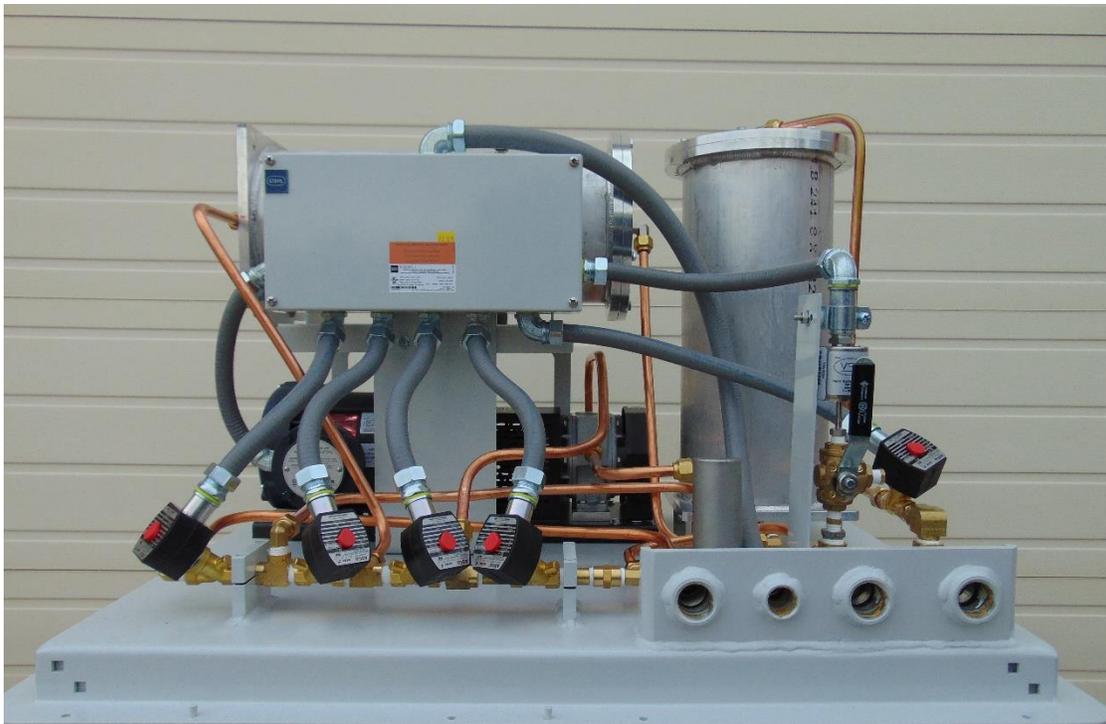
## GREEN MACHINE™ - United States

(Patents Pending)  
Model # VST- GM- CS2-101-2

### **Installation, Operation, Maintenance, & Troubleshooting Manual**

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## About VST



Vapor Systems Technologies, Inc. began in 1990 with the vision of **One Company – One Integrated Solution.**

Today, that philosophy is still in place and getting stronger. Recognizing that a healthier environment is a need and not an option, VST has dedicated its undivided attention to the ever-changing, stringent regulations that govern fugitive vapors at gasoline dispensing facilities (GDF). To this challenge, VST is committed to a continual R&D campaign of developing the most current, technologically advanced solutions to service not only the United States, but also the world.

VST specializes in the development, engineering, and manufacturing of products that are sold into the GDF segment of the petroleum industry. The VST focus provides our customers and users with exceptional products, services, and innovative solutions for improving the fueling-station experience as well as the world's air quality.

VST's product offering includes curb pump and vapor recovery hoses, safety breakaways, nozzles, and emission-control system - GREEN MACHINE. The ENVIRO-LOC™ vapor-recovery product offering represents the most innovative concept in the industry for trapping fugitive vapors from the front end (vehicle refueling) to the back end (vent risers) of the GDF site.

## Notice

Vapor Systems Technologies, Inc. shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this publication.

No part of this publication may be translated to another language without the prior written consent of Vapor Systems Technologies, Inc.

## Warranty

See the VST website for full warranty statement: <http://www.vsthose.com/warranty>



# Safety

	<b>ELECTRICITY</b> A potential shock hazard exists. High voltage is supplied to and exists in this device.		<b>TURN POWER OFF</b> Turn power OFF to the device and its accessories when installing and servicing the unit. Live power creates a potential spark hazard.
	<b>EXPLOSIVE</b> Gasoline and its vapors are extremely explosive if ignited.		<b>NO POWER TOOLS</b> Sparks from electric power tools can ignite gasoline and its vapors.
	<b>FLAMMABLE</b> Gasoline and its vapors are extremely flammable.		<b>NO PEOPLE IN THE AREA</b> Unauthorized people in the work area during installation and service of the device create a potential for personal injury.
	<b>NO SMOKING</b> Gasoline and its vapors can be ignited by sparks and embers of burning cigarettes.		<b>READ ALL RELATED MATERIALS</b> Read, understand, and follow all instructions, warnings, and requirements before you begin work.
	<b>NO OPEN FLAMES</b> Open flames from sources like lighters and matches can ignite gasoline and its vapors.		<b>USE SAFETY BARRICADES</b> Unauthorized people in the work area during installation and service of the device create a potential for personal injury. Therefore, always isolate your work area by using safety cones, barricades, etc.
	<b>PINCH RISK</b> Stay clear. Keeps hands and tools away from rotating machinery and moving parts.		<b>ROTATING MACHINERY</b> Stay clear. Keep hands and tools away from rotating machinery.



Safety, continued...



- The GREEN MACHINE will be installed near locations where highly flammable and explosive gasoline vapors may be present.
- Installation of the GREEN MACHINE must comply with the National Electric Code, federal, state, and local codes, as well as other applicable safety codes.
- Use extreme caution due to the risk of fire or explosion, which could result in serious injury or even death.



- If you are working in an area where vehicle traffic may occur, always block off the work area during installation, testing, and service to protect yourself and others.
- Do not use power tools that can generate sparks if there is a risk of flammable or explosive vapors being present.



- Read and understand all materials related to installing, testing, and operating the GREEN MACHINE prior to installation.

**CAUTION: ALL SERVICEABLE / REPLACEMENT PARTS MUST BE OBTAINED FROM VST TO MAINTAIN SUITABILITY FOR A DIVISION 2 LOCATION.**

## Table of Terms & Abbreviations

<b>ASC:</b>	Authorized Service Contractor	<b>Permeate:</b>	Air return to atmosphere
<b>ATG:</b>	Automatic Tank Gauge	<b>PMC:</b>	Pressure Management Control
<b>CVLD:</b>	Continuous Vapor Leakage Detection, another name for Vapor Leak Detection	<b>PTO:</b>	Permit to Operate
<b>EVR:</b>	Enhanced Vapor Recovery	<b>P/V Valve:</b>	Pressure Vacuum Valve
<b>GDF:</b>	Gasoline Dispensing Facility	<b>RVP:</b>	Reid Vapor Pressure
<b>GM:</b>	GREEN MACHINE	<b>TLS:</b>	Tank Level System
<b>ISD:</b>	In-Station Diagnostics	<b>TS:</b>	Troubleshooting
<b>MAG Probe:</b>	A type (brand) of Tank Inventory Probe	<b>Ullage:</b>	Vapor space above liquid in a UST
<b>NEC:</b>	National Electric Code	<b>UST:</b>	Underground Storage Tank
<b>NFPA:</b>	National Fire Protection Association	<b>VCK:</b>	Vapor Collection Kit
<b>ORVR:</b>	On-Board Refueling Vapor Recovery	<b>VOC:</b>	Volatile Organic Compounds
<b>OSHA:</b>	Occupational Safety Health Administration	<b>VST:</b>	Vapor Systems Technologies, Inc.
<b>PLC:</b>	Programmable Logic Controller	<b>IWC:</b>	Inches Water Column

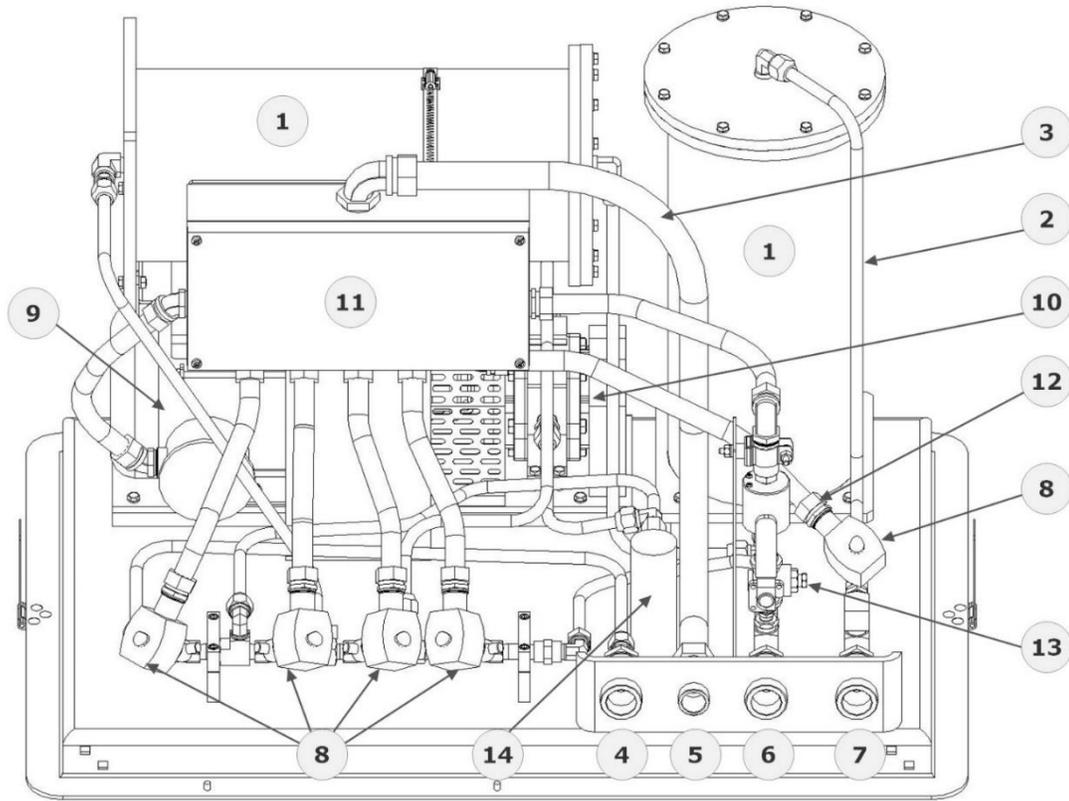


## Regulations & Jurisdiction

- Under vapor recovery regulations, local and national authorities have primary authority for regulating gasoline stations.
  - Before modifying the facility, gasoline station operators should contact the national and local authorities for specific information and requirements on local vapor-recovery requirements.
    - Be sure to read and understand all site requirements before beginning an installation.
  
- “The area inside the GREEN MACHINE cover has been evaluated as a Class I, Division 2 hazardous area as defined by the National Electric Code /NFPA 70 Article 514 table 514.3(B)(1) and verified by Intertek”
  
- Always obtain approval from the local authority having jurisdiction.
  
- Installation of the GREEN MACHINE must comply with (if applicable):
  - Fire Marshal
  - Water Board
  - Local Air Pollution Dist.
  - ICC
  - NEC
  - NFPA 30 and 30A
  - UL/ETL
  - Any other applicable federal, state, and local codes



# GREEN MACHINE Overview



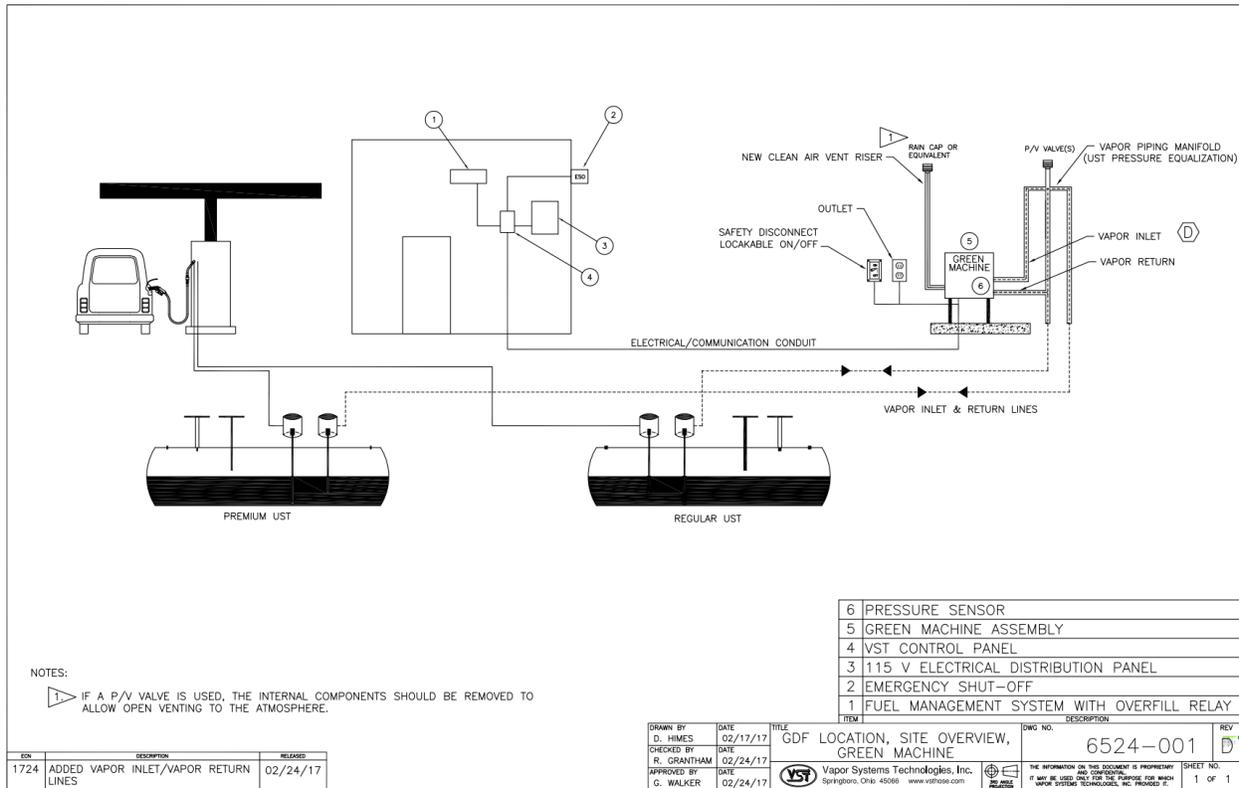
Green Machine Dual Canister Overview Listing, 09-19-2019

Ref#	Part Name	Part Description
1.	Vapor Filtration Cartridge Assemblies (2 each)	Captures and cleans VOC's from the vapor emissions
2.	Vapor Piping	Piping for the transfer of vapor
3.	Liquidtight Flexible Conduit	Used for installing wires to the junction box
4.	1" NPT Vapor Inlet Connection	Port for pulling vapors from the UST
5.	3/4" Electrical Connection	Conduit connection for wirings from the Control Panel to the GREEN MACHINE
6.	1" NPT Vapor Return Connection	Port for returning vapors to the UST
7.	1" NPT Air Outlet Connection	Port for venting air to atmosphere
8.	Control Valves (5 each)	Controls the flow of vapor and air
9.	Vac Pump Motor Only	Drives the Vacuum Pump
10.	Vac Pump Only	For transporting vapors to and from the UST
11.	Internal Junction Box	Houses all wiring connections for the Control Panel to the GREEN MACHINE
12.	Pressure Sensor	Used to monitor the UST vapor pressure
13.	Pressure Sensor Isolation Valve	Open: During normal operation for line pressure Close: To prevent the Pressure Sensor from damage during testing
14.	Separator	Protects Vacuum Pump from debris



# GREEN MACHINE Theory of Operation

- The VST GREEN MACHINE operates based on monitoring the Underground Storage Tank (UST) system pressure.
- The GREEN MACHINE controller provides UST pressure data via a pressure transducer, located in the GREEN MACHINE, and manages the GREEN MACHINE operation.
- The pressure data is provided to the VST Control Panel for system monitoring functions.
- The closed loop vapor piping solution continuously operates the system to control UST pressure below 0.2 IWC.





## GREEN MACHINE Dimensions & Weight

Unit	Dimensions	Weight
GREEN MACHINE	L-39" x W-27" x H-49.89" Height includes 24" legs	282 lbs. w/out Cover w/out Control Panel
Aluminum Cover	L-39" x W-27" x H-25" (one-piece unit)	24 lbs.
VST Control Panel	L-14" x W-12" x H-8"	22 lbs.

### How the GREEN MACHINE is Shipped

- **Verify that all the items are in the shipping crate:**
  - GREEN MACHINE - VST-GM-CS2-101-2
  - Aluminum Cover
  - VST Control Panel
  - (4) 24" Steel Legs
  - (16) 3/8" bolts / washers / nuts to attach the legs to the GREEN MACHINE base
  - (1) 0.063" dia. Orifice
  - (6) Locks with keys (same)
  - (3) 1" Brass Full Port Ball Valves, Locking
  - Packet #1: Station Owner/Operator Paperwork
  - Packet #2: General Contractor Paperwork
  - Packet #3: Vapor Piping Installation
  - Packet #4: Electrical Installation
  - Packet #5: Start-Up and Testing Contractor Paperwork
- **Shipping Check**
  - When you open the container:
    - Verify that all the items are in the shipping container.
    - Visually inspect all the items for any obvious damage.



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# Chapter 1: General Contractor Installation

## 1 Installation Instructions

### 1.1 Installation Safety for all Contractors

	<ul style="list-style-type: none"><li>• The GREEN MACHINE will be installed near locations where highly flammable and explosive gasoline vapors may be present.</li></ul>
	<ul style="list-style-type: none"><li>• Installation of the GREEN MACHINE must comply with the National Electric Code, federal, state and local codes, as well as other applicable safety codes.</li></ul>
	<ul style="list-style-type: none"><li>• Use extreme caution due to the risk of fire or explosion, which could result in serious injury or even death.</li><li>• If you are working in an area where vehicle traffic may occur, always block off the work area during installation, testing, and service to protect yourself and others.</li><li>• Do not use power tools that can generate sparks if there is a risk of flammable or explosive vapors being present.</li><li>• Read and understand all materials related to installing, testing, and operating the GREEN MACHINE prior to installation.</li></ul>

### 1.2 Preparing the GREEN MACHINE for Installation

Follow these steps to prepare the GREEN MACHINE for installation:

1. Verify that all the items are in the shipping crate:
  - GREEN MACHINE - VST-GM-CS2-101-2
  - Aluminum Cover
  - VST Control Panel
  - (4) 24" Steel Legs
  - (16) 3/8" bolts / washers / nuts to attach the legs to the GREEN MACHINE base
  - (1) 0.063" dia. Orifice
  - (6) Locks with keys (same)
  - (3) 1" Brass Full Port Ball Valves, Locking
2. Visually inspect all the items for any obvious damage.
3. CAUTION: Uncrate and install the four legs on the GREEN MACHINE prior to transporting to the installation site. Installing the legs on site without proper support may cause damage to the unit.



### 1.3 Installing the Legs on the GREEN MACHINE

1. Support the GREEN MACHINE with a forklift or a set of saw horses so the legs can be installed.
2. Install the 4 legs on the GREEN MACHINE. The four 3/8" carriage bolts for each leg MUST BE INSTALLED AND TIGHTENED IN THE SEQUENCE INDICATED ON **Figure 1-1**.
3. All the carriage bolts must be installed so the head of the bolt is flush with the base as shown.

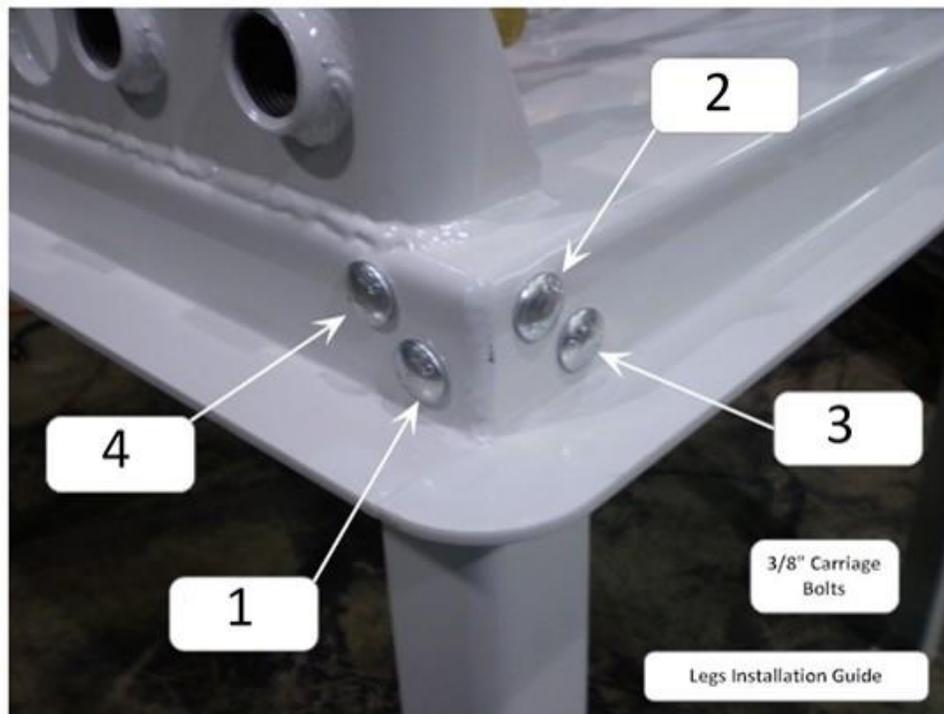


Figure 1-1: Bolting sequence to attach legs to the GREEN MACHINE base



## 1.4 GREEN MACHINE Dimensions & Weight

Unit	Dimensions	Weight
GREEN MACHINE	L-39" x W-27" x H-49.89" Height includes 24" legs	282 lbs. w/out Cover w/out Control Panel
Aluminum Cover	L-39" x W-27" x H-25" (one-piece unit)	24 lbs.
VST Control Panel	L-14" x W-12" x H-8"	22 lbs.

## 1.5 Ground Mount Locations

- NOTE: Minimum vapor-piping slope must always be maintained for all GREEN MACHINE mounting options.
  - VST requires a minimum slope of  $\frac{1}{4}$ " per foot on all vapor piping away from the GREEN MACHINE to the vent risers.
  - Select a location for the concrete pad as close as possible to the vent risers to minimize piping and pressure drop.
- The GREEN MACHINE must be protected from damage:
  - Install bollards or another suitable method to protect the GREEN MACHINE.
- VST recommends a clear 18" perimeter around the GREEN MACHINE for maintenance and testing.
- The GREEN MACHINE must be located within 100 feet of the vent risers.
- To minimize the installation cost and to maximize operating efficiency, locate the GREEN MACHINE adjacent to the existing vent risers.
- A new air outlet vent riser connected to the GREEN MACHINE must be installed to release air to the atmosphere.
- VST recommends setting the GREEN MACHINE on a concrete pad with the following minimum dimensions: 42" long x 30" wide, 6" thick.
  - Install the concrete pad as outlined in this manual.
- Follow the local jurisdiction's building codes.
- VST does not provide any hardware to install the GREEN MACHINE on the pad.



## 1.6 Setting the Concrete Pad

- The soil must have the following capabilities:
  - Allowable bearing pressure: 1000 psf
  - Lateral bearing: 150 psf
  - Coefficient of sliding: 0.25
- The GREEN MACHINE must be installed on a concrete pad, on grade, and permanently anchored to the concrete pad.
  - Install the concrete pad level.
  - Use steel re-enforced rebar in the pad for additional strength.
  - The GREEN MACHINE CANNOT be installed directly on or anchored directly to asphalt. It must be installed and anchored directly to a concrete pad.
- The GREEN MACHINE can be installed on an existing concrete pad, provided:
  - The existing concrete is of sufficient strength and thickness to support the GREEN MACHINE.
  - VST recommends a minimum of 6" thick concrete to accommodate 3-1/2" – 4" expansion-type anchor bolts.
  - Cracked concrete without re-bar may NOT be of sufficient strength to properly support the GREEN MACHINE.
  - The GREEN MACHINE is installed level.
  - NOTE: VST CANNOT BE HELD RESPONSIBLE FOR DAMAGE CAUSED BY IMPROPER GREEN MACHINE FOUNDATION SUPPORT.
- VST does not provide any hardware to install the GREEN MACHINE on the pad.
- VST recommends using an 18" minimum clearances around the perimeter of the GREEN MACHINE for maintenance and service.
- Concrete pad minimum dimensions:
  - 42" long x 30" wide
  - 6" thick (minimum)
  - **See Figures 1-2 and 1-3**
- Install expansion-type bolts after completing the concrete pad. The bolts must be:
  - 3/8" diameter
  - Embedded 3-1/2" to 4" into the slab
  - Extend approx. 1-1/2" above the top of the slab



## 1.7 Installing the GREEN MACHINE on the Concrete Pad

- After the concrete has properly cured, install the expansion anchor bolts according to the manufacturer's recommendations. **See Figures 1-2 and 1-3.**
- For applications that require expansion anchors that are especially suited to seismic and cracked concrete, VST recommends using the HILTI KWIK TZ (KB-TZ) BOLT, KB-TZ 3/8" X 5", (item number 00304583) or approved equal.
- The contractor or design engineer is responsible for sizing the expansion anchors and the concrete pad to meet seismic and cracked concrete specifications required by local, state, and federal jurisdictions.
  - Since seismic regulations may be different by location, VST has not included a specific drawing for this application.
  - For seismic design reference, [www.us.hilti.com](http://www.us.hilti.com).
- After the appropriate anchor bolts have been installed, position the GREEN MACHINE onto the anchor bolts in the cement slab.
- Bolt the GREEN MACHINE into place (according to the manufacturer recommended installation guidelines) with 3/8" galvanized lock washers and bolts that are included with the expansion bolt.

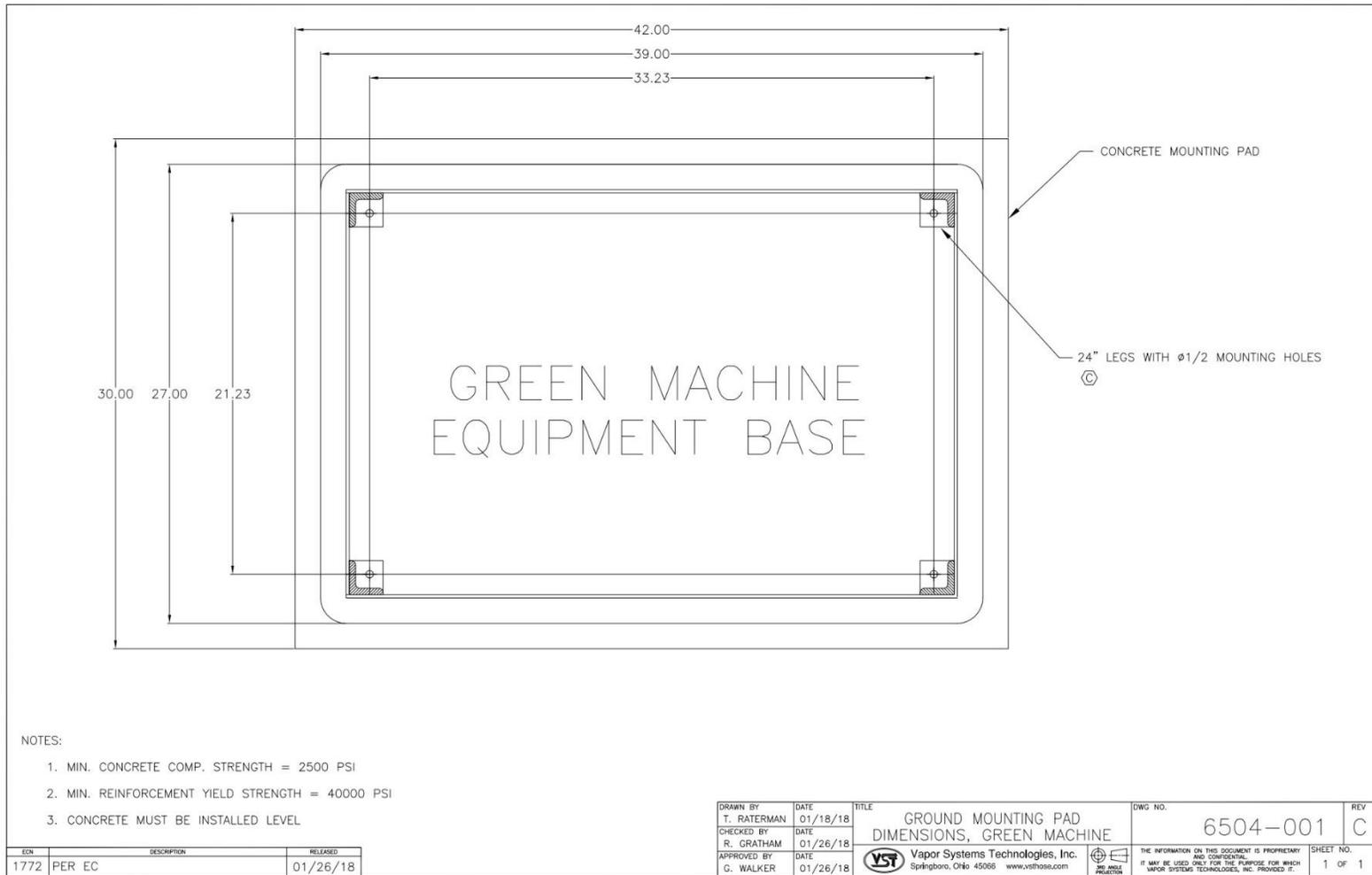


Figure 1-2: Concrete mounting pad dimensions

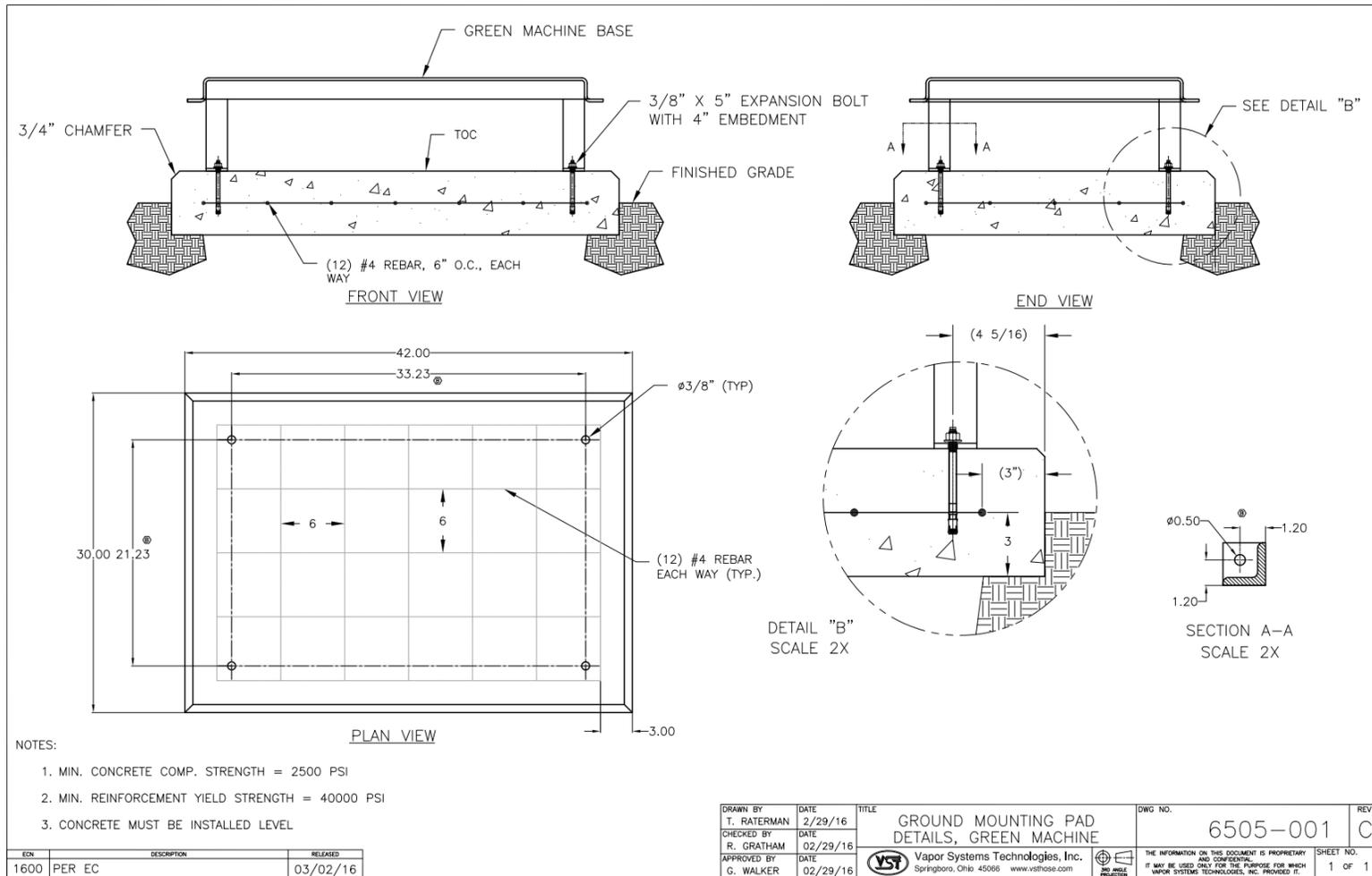


Figure 1-3: GREEN MACHINE Ground Mounting Pad



## 1.8 Roof-Top Installation

- NOTE: Minimum vapor-piping slope must always be maintained for all GREEN MACHINE mounting options.
  - VST requires a minimum slope of  $\frac{1}{4}$ " per foot on all vapor piping away from the GREEN MACHINE to the vent risers.
- The GREEN MACHINE may be installed on a station's roof provided the structure can support the weight of the GREEN MACHINE.
- All safety and code concerns must be taken into consideration prior to a roof-top installation.
- Due to a variety of roof construction designs, VST cannot recommend how the GREEN MACHINE should be mounted on the roof; however, the GREEN MACHINE must be installed at a height allowing the piping inlet and outlets to be above or through the building parapet.
- The GREEN MACHINE has 24" legs that can be bolted on the base, but the legs may be removed and the GREEN MACHINE secured to a steel structure attached to the roof.
- A new air outlet vent riser connected to the GREEN MACHINE must be installed to release air to the atmosphere.
- A Design Engineer is responsible for designing the support structure, support base, all required hardware and bolting connections, and the support structure foundation to meet all regulatory specifications that may be required by local jurisdictions.

## 1.9 Canopy-Top Installation

- NOTE: Minimum vapor-piping slope must always be maintained for all GREEN MACHINE mounting options.
  - VST requires a minimum slope of  $\frac{1}{4}$ " per foot on all vapor piping away from the GREEN MACHINE to the vent risers.
- The GREEN MACHINE may be installed on a station's canopy provided the structure can support the weight of the GREEN MACHINE.
- Due to a variety of canopy construction designs, VST cannot recommend how the GREEN MACHINE should be mounted on the canopy.
- All safety and code concerns should be taken into consideration prior to a canopy-top installation.
- The GREEN MACHINE has 24" legs that can be bolted on the base, but the legs may be removed and the GREEN MACHINE secured to a steel structure attached to the canopy support structure.

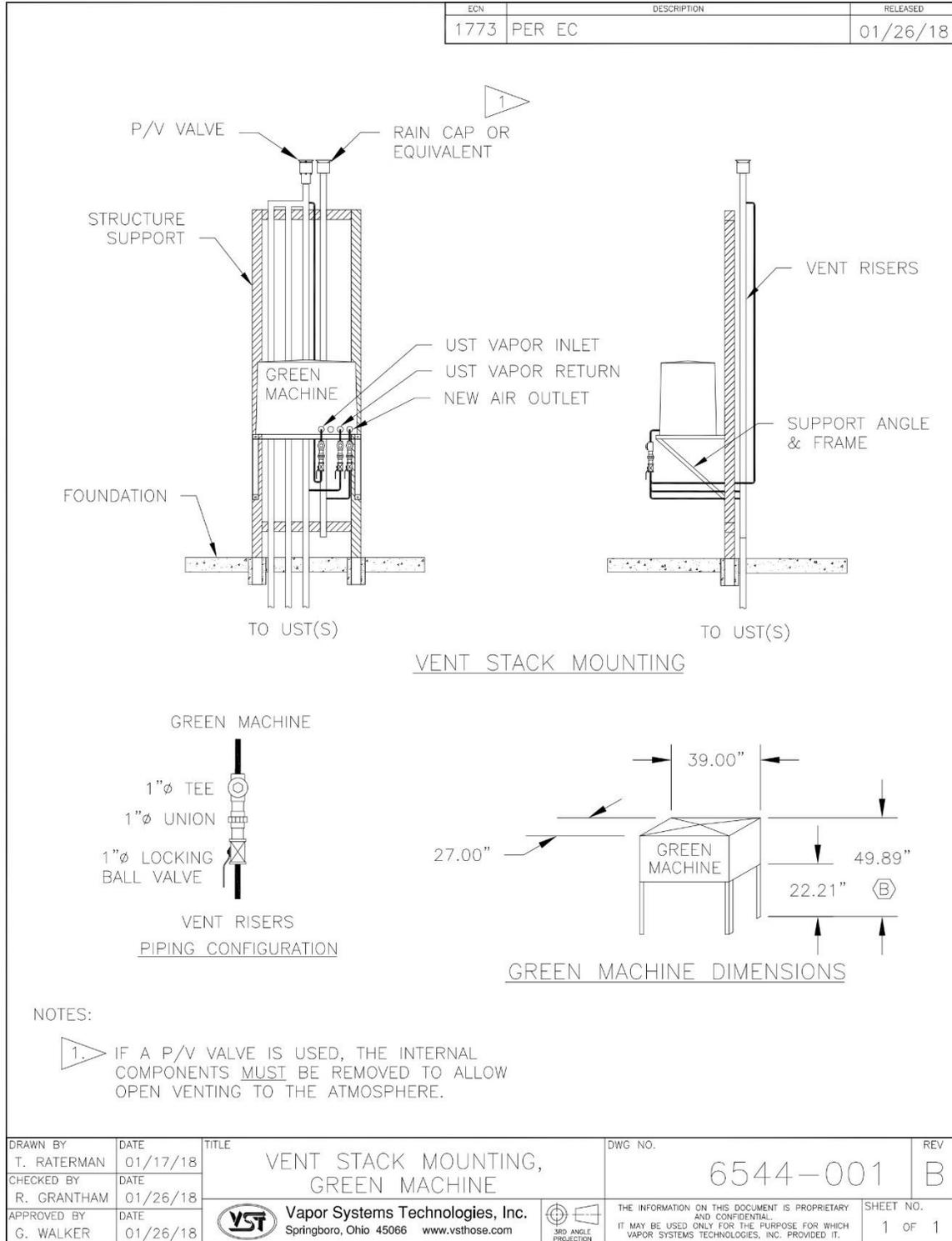


### Canopy-Top Installation, continued...

- A new air outlet vent riser connected to the GREEN MACHINE must be installed to release air to the atmosphere.
- A Design Engineer is responsible for designing the support structure, support base, all required hardware and bolting connections, and the support structure foundation to meet all regulatory specifications that may be required by local jurisdictions.

### 1.10 Vent-Stack Mount Installation

- NOTE: Minimum vapor-piping slope must always be maintained for all GREEN MACHINE mounting options.
  - VST requires a minimum slope of  $\frac{1}{4}$ " per foot on all vapor piping away from the GREEN MACHINE to the vent risers.
- The GREEN MACHINE may be installed elevated on the existing vent risers provided there is an existing structure that can support the weight of the GREEN MACHINE, or a structure can be installed to support the weight of the GREEN MACHINE.
- Due to a variety of construction designs, VST cannot recommend how the GREEN MACHINE should be installed or mounted on a vent riser support structure; however, the structure that supports the GREEN MACHINE must be designed and installed at a height allowing the piping inlet and outlets to connect to the existing vent risers.
- The GREEN MACHINE has 24" legs that can be bolted on the base, but the legs may be removed for the GREEN MACHINE to be secured to a steel support structure.
- A new air outlet vent riser connected to the GREEN MACHINE must be installed to release air to the atmosphere.
- All safety and code concerns must be taken into consideration prior to vent stack mount installation.
- A Design Engineer is responsible for designing the support structure, support base, all required hardware and bolting connections, and the support structure foundation to meet all regulatory specifications that may be required by local jurisdictions.
- **See Figure 1-4** for illustration.



**Figure 1-4: Vent Stack Installation**



### 1.11 Pre-Installation Site Survey

- Vapor Systems Technologies, Inc. created a “Pre-Installation Site Survey” as a guide to help installers and troubleshooters in the planning of a GREEN MACHINE installation.
- The “Pre-Installation Site Survey” is to be completely filled out in advance of an installation so that installation problems and delays are reduced or avoided.

### 1.12 Pre-Installation Site Survey

Your Name:	
Company Name:	
Company Address:	
City, State, Zip	
Country	
Phone:	
E-Mail:	
Projected Processor Installation Date:	

### 1.13 GDF Contact Information

GDF Name:	
GDF Address:	
GDF City, State, Zip:	
GDF Country:	
GDF Phone:	
GDF Fax:	
GDF #:	
GDF Contact Person:	
GDF Contact Person E-mail:	
NOTES:	



## 1.14 Snapshot of Site Requirements

<b>Local Air Pollution Control Districts</b>	
•	Gasoline stations must contact the local/national authorities for specific requirements.
•	Permits may be required to modify a gasoline station.
<b>Installation Requirements</b>	
•	The GREEN MACHINE must be within 100 feet of the Vent Risers regardless of the installation location.
•	VST requires a minimum slope of $\frac{1}{4}$ " per foot on all vapor-piping away from the GREEN MACHINE to the Vent Risers or to any other UST connection.
•	A minimum clearance of 18" around the GREEN MACHINE for maintenance and testing is required.
•	The GREEN MACHINE must be protected from damage: Install bollards or other suitable method to protect the GREEN MACHINE.
<b>Automatic Tank Gauge, Fuel Management Controls</b>	
•	Must have an appropriate automatic tank gauge fuel measurement control with an Overfill Alarm contact installed.
•	The GREEN MACHINE Controller will use the Overfill Alarm contacts to shut OFF the GREEN MACHINE so gasoline cannot enter the GREEN MACHINE in case of an overfill. If gasoline enters the GREEN MACHINE because of an overfill, the warranty will be voided.
<b>VST Control Panel</b>	
•	VST Control Panel completely powers the GREEN MACHINE via one 115 VAC, single-phase, 20-amp breaker.
•	The VST Control Panel arrives from the factory internally pre-wired and pre-tested.



Snapshot of Site Requirements, continued...

<b>Vent Risers</b>	
<ul style="list-style-type: none"><li>• UST's must be manifolded either above ground if there are multiple vent risers or at the vapor piping below ground.</li></ul>	
<ul style="list-style-type: none"><li>• Only one existing vent riser connected to the USTs is required for the installation of the GREEN MACHINE.</li></ul>	
<ul style="list-style-type: none"><li>• A new vent riser is required, and is connected to the Air Outlet on the GREEN MACHINE.</li></ul>	
<ul style="list-style-type: none"><li>• VST requires all vapor-piping connecting to the GREEN MACHINE must be sloped away from the GREEN MACHINE a minimum of ¼" per foot slope.</li></ul>	
<ul style="list-style-type: none"><li>• Any type of trap, regardless of the GREEN MACHINE location, is not permitted in any vapor lines connected to the GREEN MACHINE.</li></ul>	
<b>UST Manifolding</b>	
<ul style="list-style-type: none"><li>• All gasoline UST's <b>MUST</b> be manifolded either above or below ground.</li></ul>	
<b>Ground Installation Requirements</b>	
<ul style="list-style-type: none"><li>• The GREEN MACHINE must be protected from damage.</li></ul>	
<ul style="list-style-type: none"><li>• VST recommends a clear 18" perimeter around the GREEN MACHINE for maintenance and testing.</li></ul>	
<ul style="list-style-type: none"><li>• The GREEN MACHINE must be located within 100 feet of the vent risers.</li></ul>	
<ul style="list-style-type: none"><li>• To minimize the installation cost and to maximize operating efficiency, locate the GREEN MACHINE adjacent to the existing vent risers.</li></ul>	
<ul style="list-style-type: none"><li>• A new air outlet vent riser connected to the GREEN MACHINE must be installed to release air to the atmosphere.</li></ul>	
<ul style="list-style-type: none"><li>• VST recommends setting the GREEN MACHINE on a concrete pad with the following minimum dimensions: 42" long x 30" wide, 6" thick.</li></ul>	
<ul style="list-style-type: none"><li>• Follow the local jurisdiction's building codes.</li></ul>	
<ul style="list-style-type: none"><li>• VST does not provide any hardware to install the GREEN MACHINE on the pad.</li></ul>	



Snapshot of Site Requirements, continued...

<b>Roof Top Installation Requirements</b>	
<ul style="list-style-type: none"><li>• The GREEN MACHINE may be installed on a station’s roof provided the structure can support the weight of the GREEN MACHINE.</li></ul>	
<ul style="list-style-type: none"><li>• Due to a variety of roof construction designs, VST cannot recommend how the GREEN MACHINE should be mounted on the roof; however, the GREEN MACHINE must be installed at a height allowing the piping inlet and outlets to be above or through the building parapet.</li></ul>	
<ul style="list-style-type: none"><li>• All safety and code concerns must be taken into consideration prior to a roof-top installation.</li></ul>	
<ul style="list-style-type: none"><li>• The GREEN MACHINE has 24” legs that can be bolted on the base, but the legs may be removed and the GREEN MACHINE secured to a steel structure attached to the roof.</li></ul>	
<ul style="list-style-type: none"><li>• A new air outlet vent riser connected to the GREEN MACHINE must be installed to release air to the atmosphere.</li></ul>	
<ul style="list-style-type: none"><li>• A Design Engineer is responsible for designing the support structure, support base, all required hardware and bolting connections, and the support structure foundation to meet all regulatory specifications that may be required by local jurisdictions.</li></ul>	
<b>Canopy Top Installation Requirements</b>	
<ul style="list-style-type: none"><li>• The GREEN MACHINE may be installed on a station’s canopy provided the structure can support the weight of the GREEN MACHINE.</li></ul>	
<ul style="list-style-type: none"><li>• Due to a variety of canopy construction designs, VST cannot recommend how the GREEN MACHINE should be mounted on the canopy.</li></ul>	
<ul style="list-style-type: none"><li>• All safety and code concerns must be taken into consideration prior to a canopy top installation.</li></ul>	
<ul style="list-style-type: none"><li>• The GREEN MACHINE has 24” legs that can be bolted on the base, but the legs may be removed and the GREEN MACHINE secured to a steel structure attached to the canopy support structure.</li></ul>	
<ul style="list-style-type: none"><li>• A new air outlet vent riser connected to the GREEN MACHINE must be installed to release air to the atmosphere.</li></ul>	
<ul style="list-style-type: none"><li>• A Design Engineer is responsible for designing the support structure, support base, all required hardware and bolting connections, and the support structure foundation to meet all regulatory specifications that may be required by local jurisdictions.</li></ul>	



Snapshot of Site Requirements, continued...

<b>Vent Stack Installation Requirements</b>	
<ul style="list-style-type: none"><li>• The GREEN MACHINE may be installed elevated on the existing vent risers provided there is an existing structure that can support the weight of the GREEN MACHINE, or a structure can be installed to support the weight of the GREEN MACHINE.</li></ul>	
<ul style="list-style-type: none"><li>• Due to a variety of construction designs, VST cannot recommend how the GREEN MACHINE should be installed or mounted on a vent riser support structure; however, the structure that supports the GREEN MACHINE must be designed and installed at a height allowing the piping inlet and outlets to connect to the existing vent risers.</li></ul>	
<ul style="list-style-type: none"><li>• The GREEN MACHINE has 24” legs that can be bolted on the base, but the legs may be removed for the GREEN MACHINE to be secured to a steel support structure.</li></ul>	
<ul style="list-style-type: none"><li>• A new air outlet vent riser connected to the GREEN MACHINE must be installed to release air to the atmosphere.</li></ul>	
<ul style="list-style-type: none"><li>• All safety and code concerns must be taken into consideration prior to vent stack mount installation.</li></ul>	
<ul style="list-style-type: none"><li>• A Design Engineer is responsible for designing the support structure, support base, all required hardware and bolting connections, and the support structure foundation to meet all regulatory specifications that may be required by local jurisdictions.</li></ul>	

### 1.15 Other Information to Document

#### 1.15.1 Gasoline Stations

1.	Monthly throughput (gallons)	
2.	Hours open (example: 9am-11pm or 24 hrs.)	
3.	Number of Underground Storage Tanks	
4.	Size of Underground Storage Tanks (gallons)	



## 1.15.2 Dispensers

1.	Make & Model	
2.	Conventional, Assist, or Balance (OD of Vapor Pipe)	
3.	MPD or Unihose	
4.	Number of dispensers	
5.	Is the current hose a VST hose	<input type="checkbox"/> Yes <input type="checkbox"/> No
6.	Do the current hoses have a retractor	<input type="checkbox"/> Yes <input type="checkbox"/> No
7.	Curb hose length	
8.	Whip hose length	
9.	Hose configuration	<input type="checkbox"/> Standard <input type="checkbox"/> Lazy J <input type="checkbox"/> Curly Q

## 1.15.3 Vent Risers

1.	Number of vent risers	
2.	Location & size of vent risers (show on sketch)	
3.	Where are the USTs manifolded	<input type="checkbox"/> Above Ground <input type="checkbox"/> Below Ground

## 1.15.4 VST GREEN MACHINE

1.	What are the possible locations that can be used for the VST GREEN MACHINE	<input type="checkbox"/> Ground <input type="checkbox"/> Roof <input type="checkbox"/> Canopy <input type="checkbox"/> Vent Riser
2.	Will a waiver or variance be needed for a ground-mount location	<input type="checkbox"/> Yes <input type="checkbox"/> No
3.	Does the site have overfill protection?	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Can we connect to the fuel management system signal for the VST GREEN MACHINE	<input type="checkbox"/> Yes <input type="checkbox"/> No



### 1.15.5 Electrical

1.	Does the GDF have 1-Phase 115V available?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
2.	Are there any existing conduits at or near the proposed VST GREEN MACHINE location (for example: lights, signs, vacuum)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
3.	Available breaker space for a 115V 1-phase circuit?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
4.	Will a sub-panel need to be installed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No

### 1.15.6 Additional Documentation

•	Include photos of each of the above items as needed.
•	Draw a sketch of the GDF layout. Include:
a)	The location of the vent risers
b)	Tank pad
c)	Dispensers
d)	Building with the electrical panel location
e)	Property lines
f)	Any existing conduits near the proposed GREEN MACHINE location.

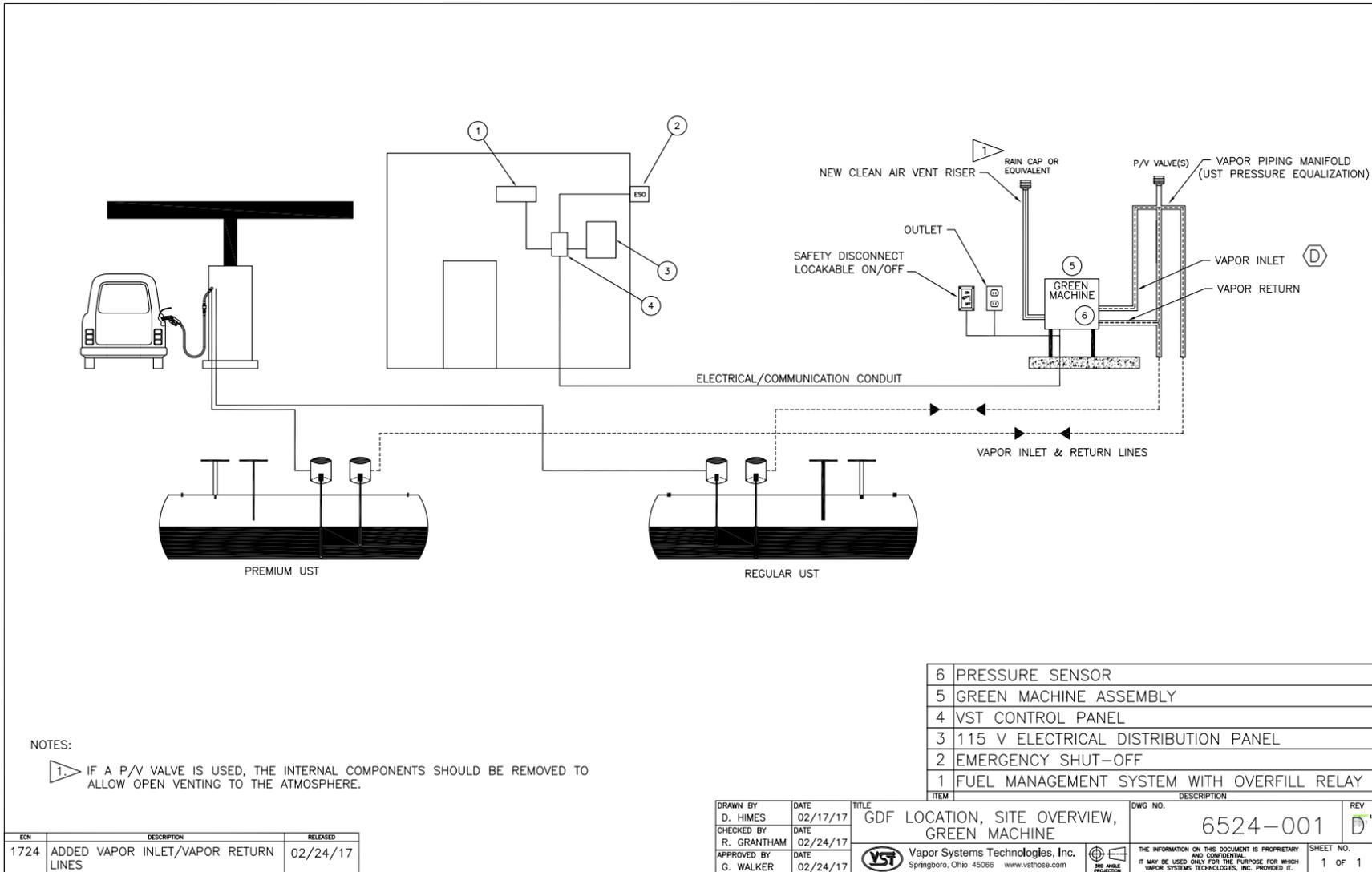


Figure 1-5: Example of a GDF Layout

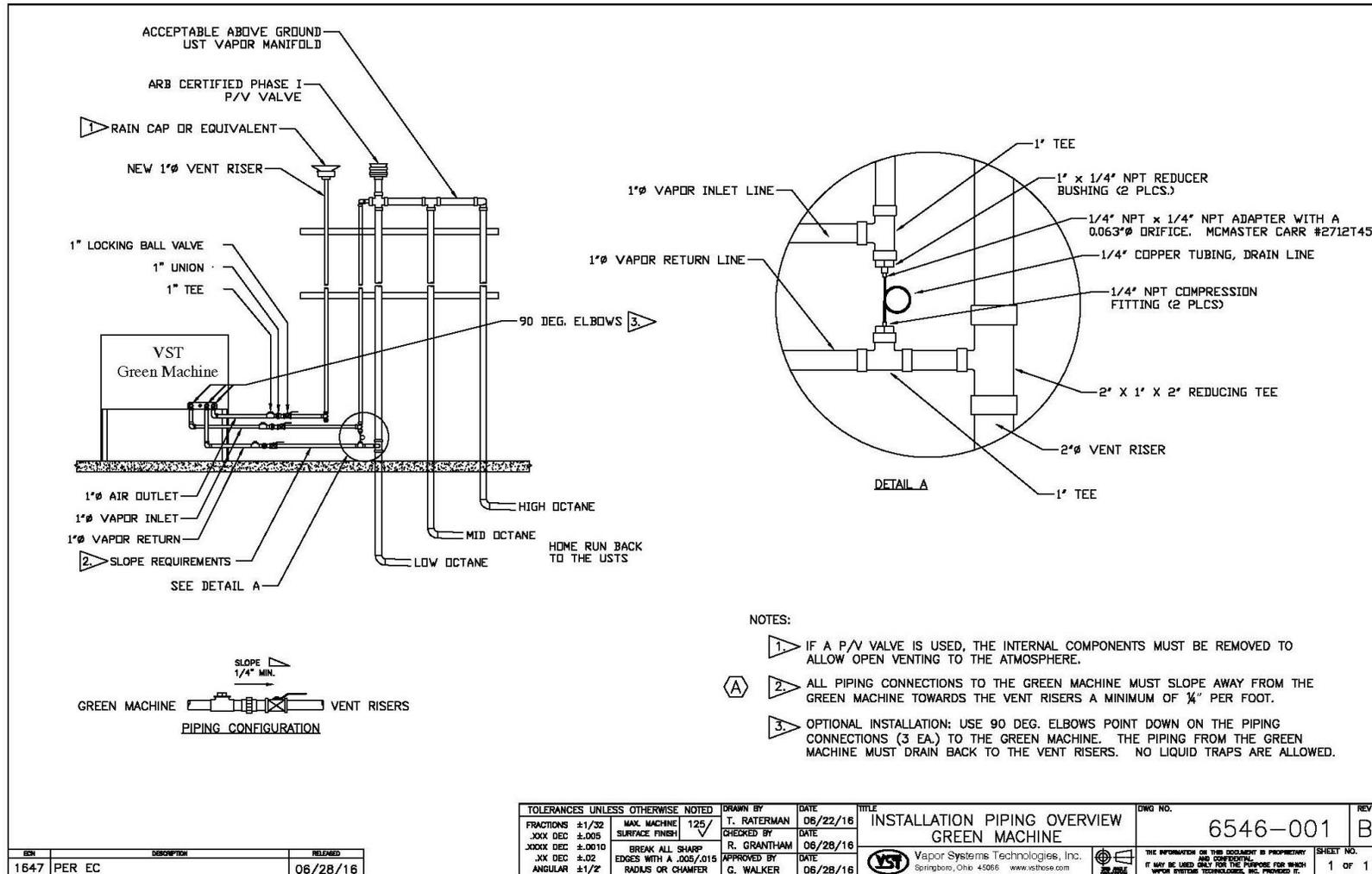
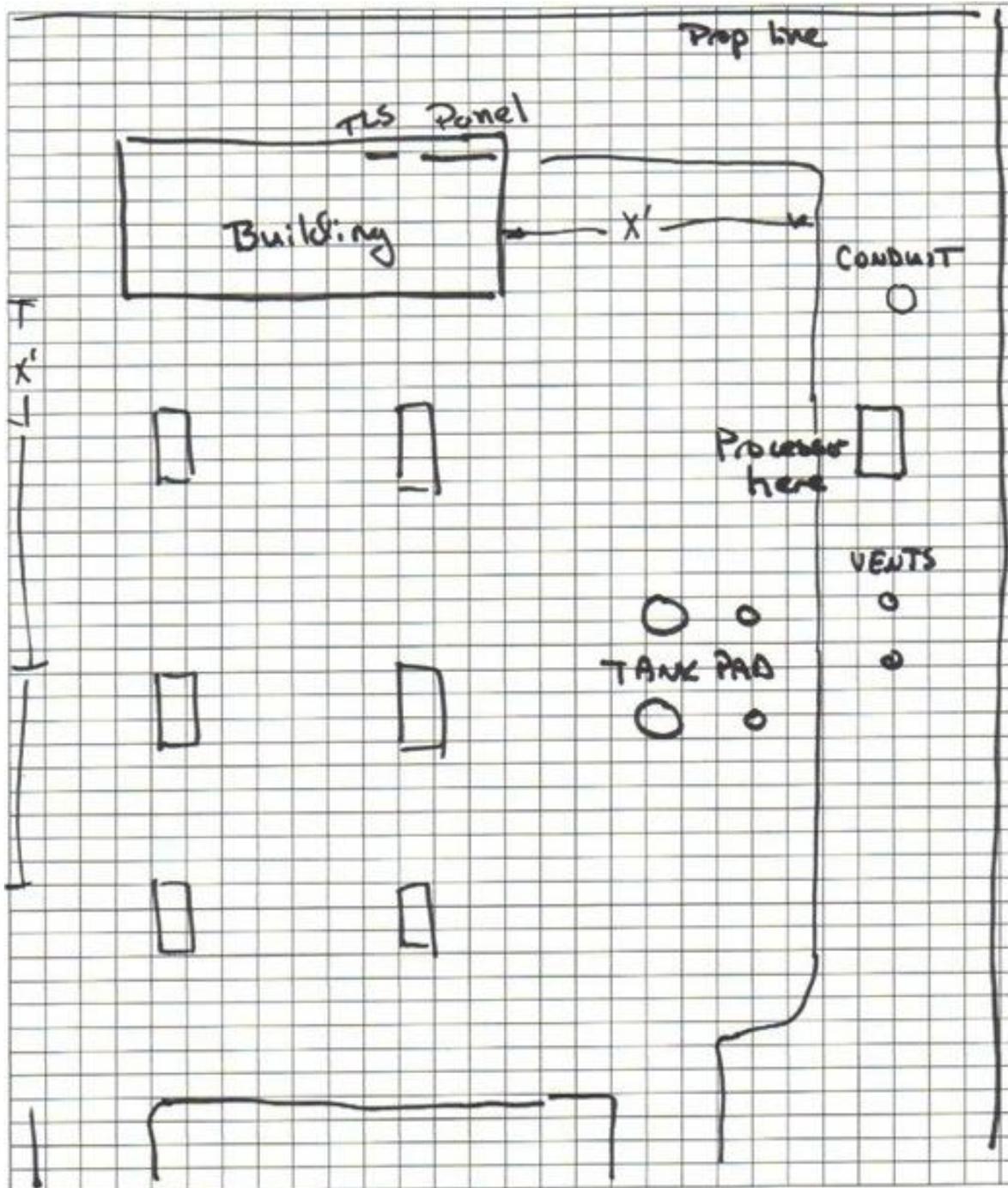


Figure 1-6: Example of a GREEN MACHINE with Vapor Piping Layout

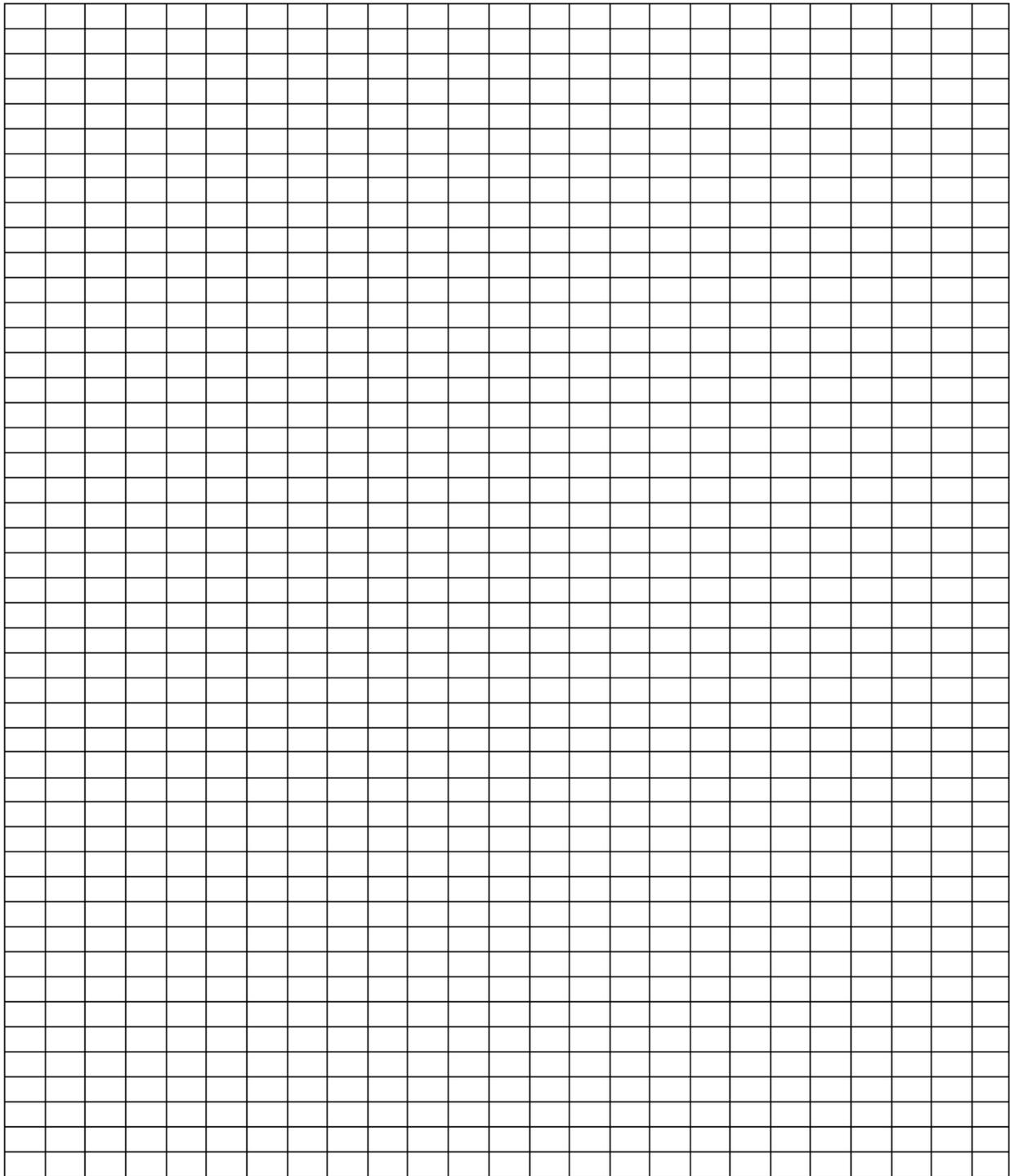


### 1.16 Sample Sketch





### 1.16.1 Your Sketch





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# Chapter 2: Vapor Piping Installation

## 2 Vapor Piping Installation Overview

- There are 3 piping connections to be made to the GREEN MACHINE. **See Figures 2-1 & 2-2:**
  - Vapor Inlet (supply) from the UST's
  - Vapor (concentrate) Return to the UST's
  - Air Outlet to atmosphere
- All the GREEN MACHINE piping connections are 1" diameter National Pipe Thread (NPT).

### 2.1 General Notes

- The piping contractor is responsible for providing all necessary piping, non-hardening pipe-joint compound, and pipe fittings.
- Make sure the gasoline UST tanks vapor piping is manifolded either above ground or below ground.
- Locks must be installed on the valves to prevent unauthorized tampering of the equipment.
- Under normal operation, the valves must be locked in the OPEN position.
- VST requires a minimum slope of 1/4" per foot on all vapor-piping away from the GREEN MACHINE to the vent risers or to any other UST piping connection.
- The 1/4" diameter drain line with the supplied adapter must be installed per **Figure 2-1**.

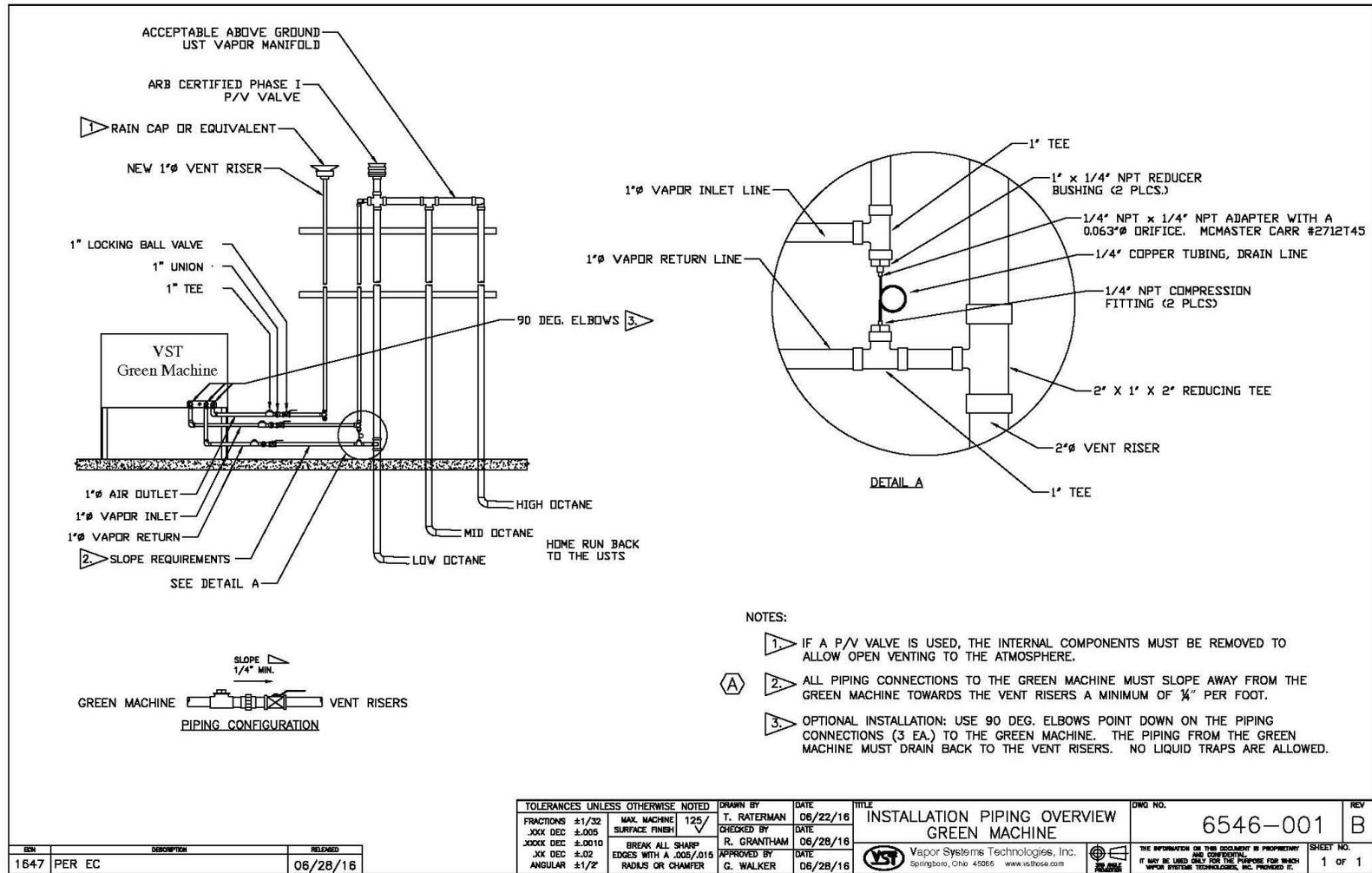


Figure 2-1: Vapor Piping Overview

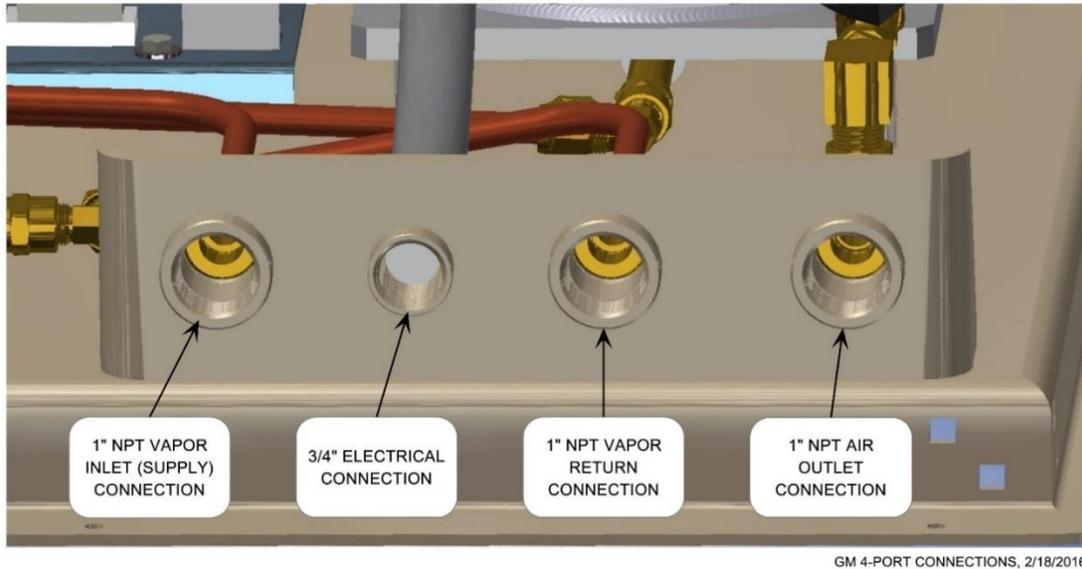


Figure 2-2: GREEN MACHINE Connections

## 2.2 Flexible Piping

- If flexible piping is required by the local authority to meet seismic requirements, install the flexible piping between the GREEN MACHINE locking ball valve and the vent riser(s).
- The flexible connector must be approved for a service station above-ground application.
- Support the flexible piping per manufacturer's recommendation.
- The slope of the flex connection from the GREEN MACHINE back to the vent riser must be a minimum of 1/4" per foot slope.
- Liquid traps are not allowed.



## 2.3 Vapor Inlet and Vapor Return Piping Installation

- Install a 1" vapor inlet pipe and a 1" vapor return pipe as shown in **Figure 2-1** from the vapor inlet and vapor return connections on the GREEN MACHINE to an existing vent riser.
- An existing vent riser that connects to the GREEN MACHINE must be modified by:
  - Adding the first tee (near the bottom of the vent riser) for connecting the 1" vapor return pipe. The first tee must be installed to allow the vapor return to slope away from the GREEN MACHINE.
  - Adding a second tee/cross (just below the P/V valve) for connecting the 1" vapor inlet pipe. The second tee/cross must be installed at the top of the vent riser, but below the P/V valve.
- Both the vapor inlet and the vapor return lines have: a 1" union, a 1" locking ball valve, and a 1" tees/caps, and any other piping fittings to complete the installation.
- The 1" vapor return pipe connecting to the bottom of the vent riser **MUST BE INSTALLED** below the 1" vapor inlet pipe that connects to the top of the vent riser.
- A ¼" drain line **MUST BE INSTALLED** between the vapor inlet and the vapor return so any condensate from the vapor inlet line can drain into the vapor return line. VST is supplying a ¼" NPT x ¼" NPT adapter with a 0.063 orifice. The orifice will eliminate any vapor flow between the vapor inlet line and the vapor return line.
- Install a tee into the vent riser that will connect to the GREEN MACHINE Vapor Inlet using 1" NPT pipe.
- The new tee must be installed to allow for slope away from the GREEN MACHINE to the vent riser.
- If there are multiple-grade UST's and multiple vent risers, VST recommends connecting the GREEN MACHINE to the lowest octane vent riser.
- From the vent riser, install the 1" locking ball valve, then the 1" union, then the 1" tee.  
**See Figure 2-1.**



## 2.4 Air Outlet Piping Installation

- Install a new vent riser next to an existing vent riser (if possible).
  - The 1" piping must slope away from the GREEN MACHINE a minimum of ¼" per foot. **See Figure 2-1.**
- Install the new dedicated vent riser so that the discharge opening is at least as high as the existing riser and a minimum of 1" diameter.
- Install a tee with a cap at the bottom of the new air outlet vent riser to provide for manual drainage.
- Make sure the ¼" drain line is installed between the vapor inlet and the vapor return lines.
- Install piping from the 1" NPT Air Outlet fitting on the GREEN MACHINE to the new vent riser.
- From the vent riser, install the 1" locking ball valve, then the 1" union, then the 1" tee as shown in **Figure 2-1.**
- A rain cap or equivalent must be installed on the new air outlet vent riser.
  - If a PV vent valve is used, the internal components must be removed to allow open venting to the atmosphere.

## 2.5 Vapor Piping Post-Installation

- After all the piping has been installed, make sure the 3 lockable ball valves are locked and in the OPEN position.
- Make sure all the pipe connections are tight.
- Make sure the slope is a minimum 1/4" per foot away from the GREEN MACHINE to the vent risers.
- Make sure there are no traps between the GREEN MACHINE and the vent risers.
- If flex piping is used, make sure the flexible piping is adequately supported.
- Make sure the ball valve below the Pressure Sensor is OPEN, or the handle is vertical. **See Figure 2-3.**
- The ¼" diameter drain line with the supplied adapter must be installed per **Figure 2-1.**

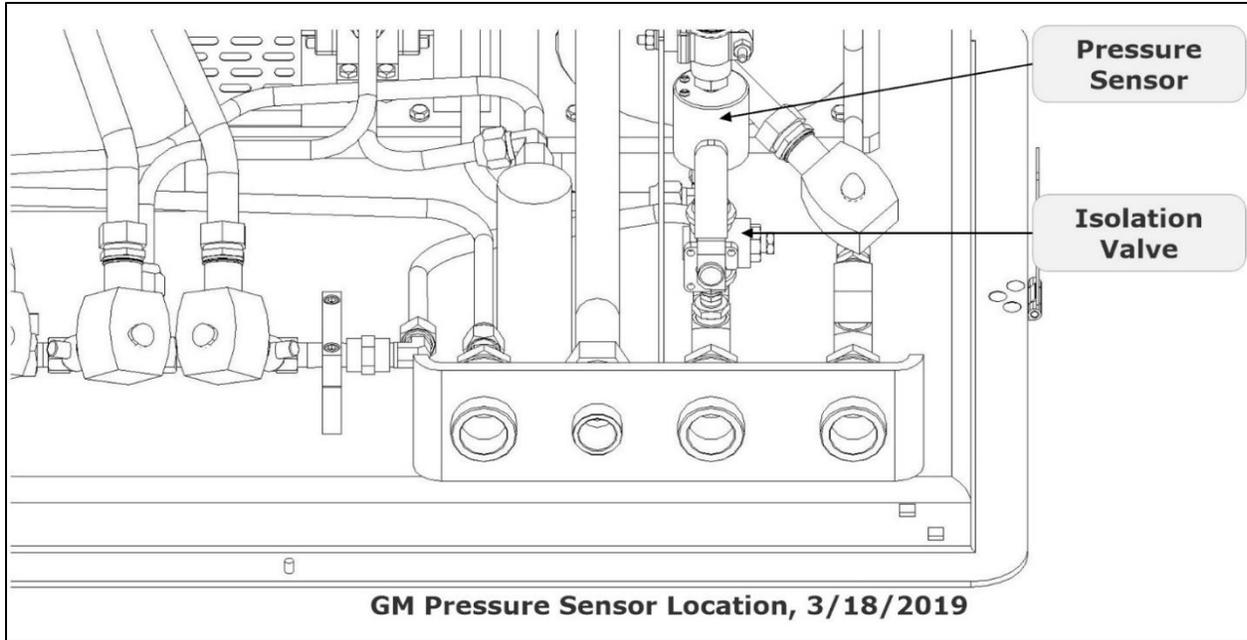


Figure 2-3: Pressure Sensor w/ 3-Way Isolation Valve Open

## 2.6 Vapor Piping Bill of Material

<b>Contractor Supplied</b>
1" diameter straight tees with caps
1" diameter unions
Straight tee (sized to match existing vent riser)
Straight tee with cap (sized to match new vent riser)
Rain cap (on the new air outlet vent riser)
1" diameter pipe, elbows, and misc. pipe fittings
Vent Stack pipe supports and hardware (as required)
¼" NPT Compression Fittings (2 each)
1" x ¼" NPT Reducer Bushing
¼" Diameter Copper Tubing
<b>Vapor Systems Technologies Supplied</b>
¼" x ¼" NPT Brass Adapter, with a 0.063" diameter orifice
(6) Locks (3-Ball Valves, 2-Cover, and 1-ON/OFF Safety Switch)
(3) 1" Brass Full Port Ball Valves, Locking



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# Chapter 3: Electrical Installation

## 3 Electrical Safety

	<ul style="list-style-type: none"> <li>• The GREEN MACHINE uses lethal voltages and operates in areas where gasoline vapor may be present.</li> <li>• Serious injury or death from electrical shock, fire, or explosion may result if the power is ON during installation, testing, or maintenance.</li> <li>• Be sure to use Lock-Out/Tag-Out procedures when working on or installing the GREEN MACHINE or while working on electrical components.</li> <li>• When performing maintenance, always power OFF electrical components connected to the GREEN MACHINE. <b>The GREEN MACHINE can start automatically.</b></li> <li>• Do not use tools that can generate sparks if there is risk of flammable or explosive vapors being present.</li> <li>• Read and understand all materials related to installing, testing, and operating the GREEN MACHINE prior to installation.</li> </ul>
--	--

### 3.1 Electrical Requirements

VST Control Panel Power Requirements							
VST CONTROL PANEL – POWER SOURCES							
<b>Option 1:</b>	Main power	1-Phase	115VAC	20	60-Hz	20-amp breaker	Electrical Panel
<b>Option 2:</b>	ESO Relay power	1-Phase	115VAC	20	60-Hz	20-amp relay	Emergency Shut-Off
Equipment	Phase	Voltage	Amperage	Frequency	Fuse/Breaker Size	Location	
Vacuum Pump Motor	1-Phase	115VAC	8.8 <small>*(See note 1)</small>	60-Hz	15-amp breaker	VST Control Panel	
Control Valves	1-Phase	115VAC	1.0	60-Hz	5-amp fuse (3 each)		
24VDC Power supply	1-Phase	115VAC	4.0	60-Hz	4-amp fuse		
Pressure Sensor		24VDC			Protected by 24VDC power supply		
GREEN MACHINE Controller		24VDC			Protected by 24VDC power supply		

\*Note 1: The 8.8 amp listed is only for the ½ HP, 115 VAC, 1-Phase, 60-Hz Leeson Motor.

Table 1: VST Control Panel Power Requirements



## 3.2 Electrical Installation

- The VST Control Panel and the GREEN MACHINE Internal Junction Box arrive from the factory pre-wired and completely tested.
- The Electrical Contractor is responsible for supplying all additional wires, conduits, fittings, seal-offs, outlets, and the Safety Disconnect Switch required to install the GREEN MACHINE and meet regulation requirements and standards.
- All wiring must be gasoline and oil resistant.
- A LOCKABLE SAFETY DISCONNECT-SWITCH MUST BE INSTALLED BY THE GREEN MACHINE:
  - Must be wired per included drawings.
  - Should be installed within eye-sight of the GREEN MACHINE for safety reasons.
  - Must not be installed within 3 feet of the GREEN MACHINE.
  - Consult the NEC for restrictions, location, and type of disconnect.
- The GREEN MACHINE is installed in a Class I, Division 2 hazardous location and therefore requires electrical seal-offs when connecting to ordinary, non-hazardous electrical locations. Consult the NEC and NFPA for installation instructions.
- All wiring (115 VAC and 24 VDC) to be TFFN or THHN with 600V insulation.
- The contractor is responsible for sizing the wire, cable, and conduit according to the NEC.
- All power (115 VAC and 24 VDC), the neutral, and the ground wires connected to the GREEN MACHINE will be disconnected when:
  - The Power Switch on the front of the VST Control Panel is turned OFF.
  - The station Emergency Shut-Off is activated.
  - The Safety Disconnect Switch at the GREEN MACHINE is opened.
  - Power is turned OFF to the VST Control Panel at the electrical distribution panel.
- CAUTION: SAFETY PRECAUTION
  - BE SURE THE GREEN MACHINE BREAKER INSIDE THE ELECTRICAL PANEL IS LOCKED OUT/TAGGED OUT PRIOR TO THE INSTALLATION.

## 3.3 Electrical Installation Code Requirements

- According to NFPA 30:
  - “Electrical wiring and electrical utilization equipment shall be a type specified by and be installed in accordance with NFPA 70. Electrical wiring and electrical utilization equipment shall be approved for the locations in which they are installed.”
- All electrical wiring and electrical utilization equipment must be installed to meet federal, state, and local codes.
- Flexible electrical conduit connections to the GREEN MACHINE may be required by local jurisdictions to meet code requirements.
- Following such procedures may be required by local, state, and national authorities.
  - You must install the GREEN MACHINE in accordance with the National Electric Code (NEC), NFPA 70, and with the Automotive and Marine Service Station Code (NFPA 30A).
  - According to NFPA 30A:  
“Electrically energized vapor-recovery equipment shall be directly connected to and controlled by the emergency pump shut off in Section 5202.4.7.”



### 3.4 Electrical Components

Existing Components	VST Supplied Components	Contractor Supplied Components
115V Main Electrical Panel	Pre-wired VST Control Panel	115V Outlet (For maintenance and testing)
Fuel Management System (TLS-350/450) or other	Pre-wired GREEN MACHINE Internal Junction Box	Lockable Safety Disconnect-Switch
Overfill Alarm Output Relay (4-Relay Module)		All conduit, wire, cable, fittings, and seal-offs, and any other electrical material to complete the electrical installation
Emergency Shut-Off (ESO)		

Table 2: Table of Electrical Components

### 3.5 Electrical Wiring Installation

**SAFETY PRECAUTION: PRIOR TO STARTING ANY ELECTRICAL WORK, BE SURE TO US LOCK OUT / TAG OUT PROCEDURES.**

**Wires Required to install the GREEN MACHINE:**

**9 WIRES AND 1 CABLE FROM THE VST CONTROL PANEL TO THE GREEN MACHINE INTERNAL JUNCTION BOX**

1. 1 Vacuum Pump 115 VAC Hot
2. 1 Common Neutral
3. 1 Common Ground
4. 1 Control Valve V1 115 VAC Hot
5. 1 Control Valve V2 115 VAC Hot
6. 1 Control Valve V5 115 VAC Hot
7. 1 Safety Switch 115 VAC Hot
8. 1 Safety Ground
9. 1 Safety Switch Ground
10. 1 Cable, 3 conductors, 18 AWG, twisted pair, shielded ground

**IN ADDITION, THERE ARE 3 WIRES FOR THE 115 VAC OUTLET FROM THE ELECTRICAL DISTRIBUTION PANEL**

1. 1 Outlet 115 VAC Hot
2. 1 Outlet Neutral
3. 1 Outlet Ground

#### 3.5.1 INSTALLING THE VST CONTROL PANEL:

- The contractor must drill holes in the VST Control Panel for all wiring connections.
- Install the VST Control Panel only inside the GDF. The location may vary within the GDF given the allowable space.
  - When possible, place the VST Control Panel as close to the Fuel Management System as possible.
- After the Control Panel is installed and power applied to the panel, **Figure 3-1** shows the Main Screen with the GM DISABLED – ENTER CODE label, which will be discussed later in this Chapter.



### 3.5.2 OPTION 1: Power To The Vst Control Panel From The Main Electrical Distribution Panel.

**Figure 3-2:** Is an Electrical Overview Drawing for Reference for Option 1.

**Figure 3-3:** **Wiring the Supply Power to the GREEN MACHINE from a Main Electrical Distribution Panel:**

1. Make sure the 20-amp breaker used for the GREEN MACHINE inside the distribution panel is turned OFF and follow Lockout-Tagout safety procedures.
2. Install the 115 VAC power, the neutral, and the ground wires from the main distribution panel to the VST Control Panel.
3. Wiring:
  - L1 115 VAC Hot to Wire Number 02011
  - Neutral to Wire Number 02012
  - Ground to Ground

**Wiring the VST Control Panel to the ESO Relay:**

1. When activated, the ESO will turn OFF and disconnect power, the neutral, and ground from the GREEN MACHINE.
2. Two wires **MUST BE INSTALLED** from the VST Control Panel to the ESO relay or control system. The technician making these connections **MUST BE CERTIFIED** to work on this system.
3. Reference the ESO terminal block wire numbers.
4. Wiring:
  - 115 VAC to Wire Number 02011
  - 115 VAC Switch Leg to Wire Number 02032

### 3.5.3 OPTION 2: Power The Vst Control Panel From The Station Emergency Shut-Off (Eso) Relay.

**Figure 3-4:** Is an Electrical Overview Drawing for Reference for Option 2.

**Figure 3-5:** **Supply Power to the GREEN MACHINE from the ESO Relay:**

1. Make sure the ESO Relay is 20A or higher.
2. Install the 115 VAC power, the neutral, and the ground wires from the ESO Relay to the VST Control Panel.
  - ESO L1 115 VAC Hot to Wire Number 02011
  - ESO Neutral to Wire Number 02012
  - ESO Ground to Ground

**Wiring the VST Control Panel ESO Relay Jumper:**

1. Since the VST Control Panel power is wired to the station ESO Relay, a jumper **MUST** be installed inside the panel.
2. Install the jumper wire inside the VST Control Panel.
  - Wire Number 02011
  - To Wire Number 02032



### 3.5.4 Wiring the Electrical Components at the GREEN MACHINE Location.

**Figure 3-6: Shows the Field Wiring from the VST Control Panel to the GREEN MACHINE Internal Junction Box: Vacuum Pump Motor, Pressure Sensor, Safety Power Switch**

1. Wiring the Internal Junction Box
  - a. Install 6 wires from the VST Control Panel to the junction box
    - a. Vacuum Pump 115 VAC to wire number 02052
    - b. Vacuum Pump Neutral to wire number 02042
    - c. Control Valve V1 115 VAC to wire number 02062
    - d. Control Valve V2 115 VAC to wire number 02072
    - e. Control Valve V5 115 VAC to wire number 02074
    - f. Ground to Ground
2. Pressure Sensor Cable
  - a. Install 1-Pressure Sensor Cable from the VST Control Panel to the Internal Junction Box
  - b. The cable is supplied by the contractor
  - c. The cable must be 3-conductor, 18 AWG, twisted and shielded
    - 24 VDC (+) to wire number 02092
    - 4-20 mA SIGNAL to wire number 04052
    - Shielded ground (Lead wire is a bare ground)
3. Safety Disconnect Switch
  - a. Install 2 wires from the VST Control Panel to the Safety Disconnect Switch
    - 115 VAC to wire number 02032
    - 115 VAC switch leg to wire number 02023
    - Ground to Ground

### 3.5.5 Wiring the Overfill Alarm Field Wiring

**Figure 3-6: Shows the Overfill Alarm Field Wiring from the VST Control Panel to the Fuel Management System**

1. The VST Control Panel supplies 24 VDC to an Overfill Alarm relay.
2. The Overfill Alarm output relay is a “dry” relay (N.O.) that shuts down the GREEN MACHINE when a UST reaches the Overfill Level volume during a fuel drop.
3. Install two wires from the VST Control Panel to the Fuel Management System Overfill Alarm (N.O.) output relay. (Refer to the Fuel Management System Installation Manual for connecting and configuring the correct relay. Programming of the Overfill Relay will be completed by a certified technician.)
  - a. TLS-350 or equivalent Overfill Alarm Relay Circuit.
  - b. Connect to the COMM Bay, 4-Relay Module
    - 24 VDC (+) to wire number 02092
    - 24 VDC (0) to wire number 04051
  - OR
  - c. TLS-450 PLUS or equivalent Overfill Alarm Relay Circuit
  - d. Connect to the Module Bay, I/O Module
    - 24 VDC (+) to wire number 02092
    - 24 VDC (0) to wire number 04051



### 3.5.6 Wiring the VST Control Panel to the GREEN MACHINE

**Figure 3-7: Wires from the VST Control Panel to the GREEN MACHINE Internal Junction Box Wiring Diagram.**

1. This drawing is used for wiring from the VST Control Panel to the Internal Junction Box for the Vacuum Pump Motor, the 5-control valves, and the Pressure Sensor. For Reference.

### 3.5.7 Wiring the Pressure Sensor

**Figure 3-8: Wiring Diagram of the Pressure Sensor.**

1. This drawing is used for wiring from the Internal Junction Box to the Pressure Sensor located inside the GREEN MACHINE cover.

### 3.5.8 Vacuum Pump Motor Wiring Diagram

**Figure 3-9: Wiring Diagram of the Vacuum Pump Motor, 115 VAC, 1-phase, 50-Hz, 1725 rpm.**

1. This is the Vacuum Pump motor wiring diagram and is used to reverse the motor direction if required.

### 3.5.9 Applying Power to the VST Control Panel

After all the wiring connections listed below are completed and checked, power can be turned ON at the VST Control Panel. The following items have been installed and wired:

1. VST Control Panel
2. Emergency shut-Off Relay
3. Overfill Alarm Relay
4. GREEN MACHINE Internal Junction Box
5. Pressure Sensor
6. Safety Disconnect Switch
7. Outlet

After power is turned ON to the VST Control Panel (**See Figure 3-3**), the Main Screen will show **GM DISABLED – ENTER CODE**. This means:

1. The VST Control Panel has power through the Distribution Panel or the ESO Relay.
2. The GREEN MACHINE cannot operate because Testing & Start-Up has not been completed.
3. The GREEN MACHINE cannot be started by the Electrical Contractor.
4. **See Figure 3-1:** VST Control Panel PLC Main Screen – GM Disabled – Enter CODE Main Screen

Before turning OFF power the VST Control Panel, check to make sure there are no GREEN MACHINE Alarms. **See Figure 3-2.**

1. On the Main Screen, push the Faults & Alarms soft button. This will bring up the Alarms Screen.
2. All the items on the screen should be Green, indicating there are no alarms present.
  - a. Pressure Sensor Alarm
  - b. Vacuum Pump Alarm
  - c. Maint. Switch Alarm (Make sure the Maint. Switch on the front of the Control Panel is turned ON)
  - d. Overfill Alarm
3. If an Alarm is present, call Vapor Systems Technologies at 937-704-9333 for instructions.



## CAUTION: TURN OFF POWER TO THE VST CONTROL PANEL AT THIS TIME.

Make sure the Carabiner Clip is installed on the VST Control Panel locking the Power Switch in the OFF position.

The power to the VST Control Panel will be turned ON AGAIN during the GREEN MACHINE Post Installation Start-Up.

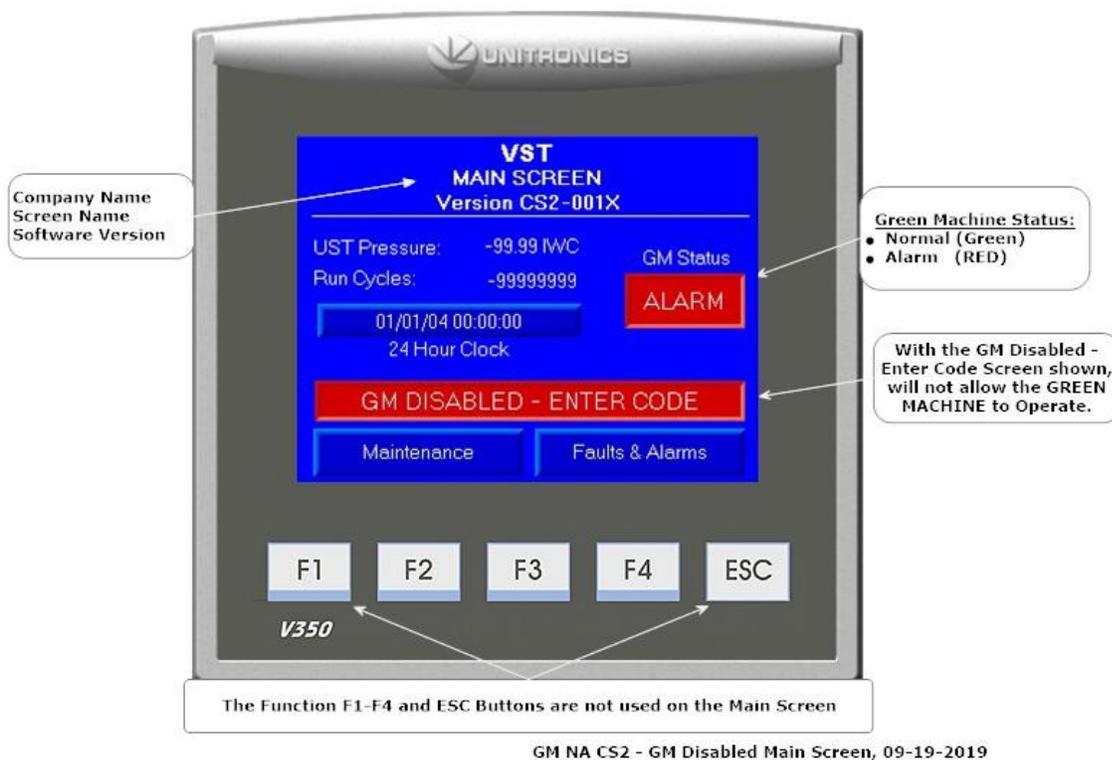


Figure 3-1: Control Panel PLC Main Screen - GM Disabled - Enter CODE Main Screen

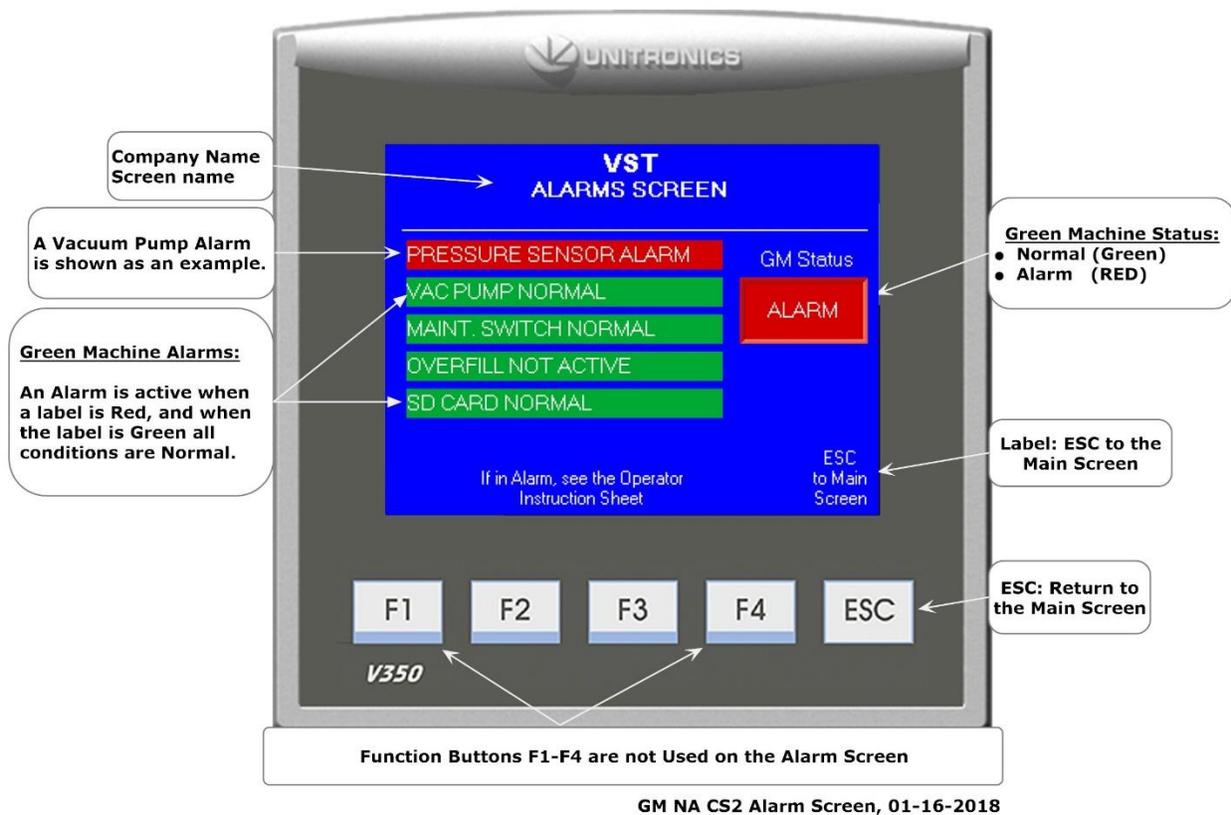


Figure 3-2: VST Control Panel PLC Alarm Screen

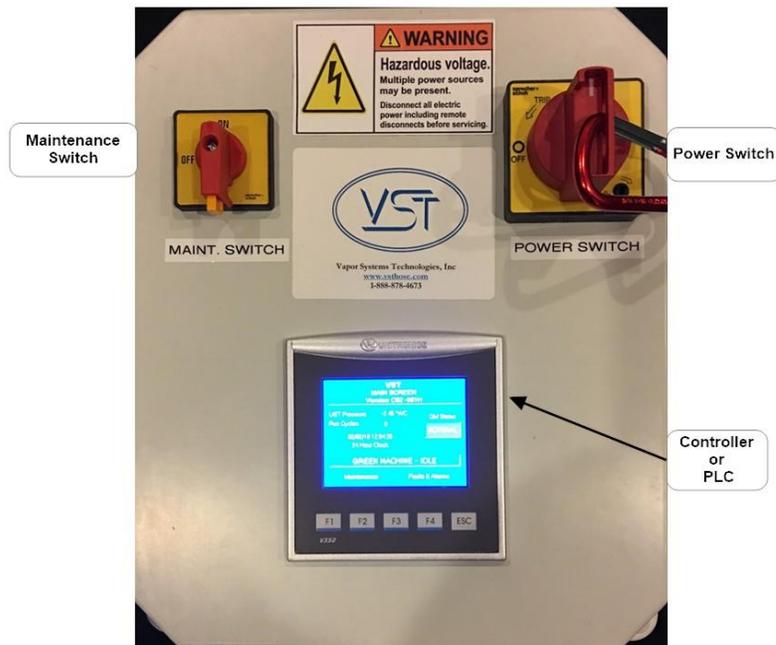


Figure 3-3: VST CS2 Control Panel w/Carabiner Clip Installed

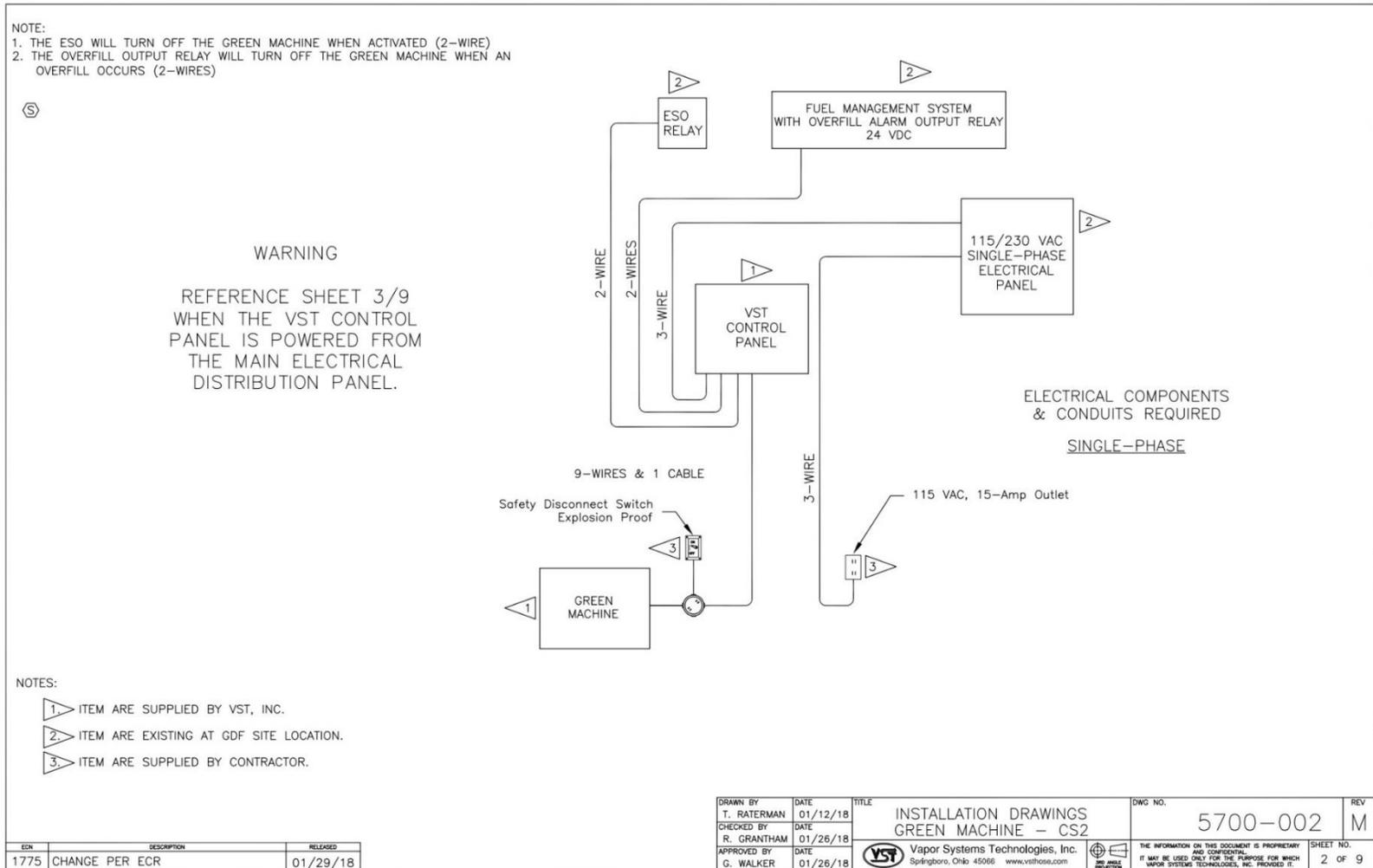


Figure 3-4: GREEN MACHINE Installation Overview Option 1

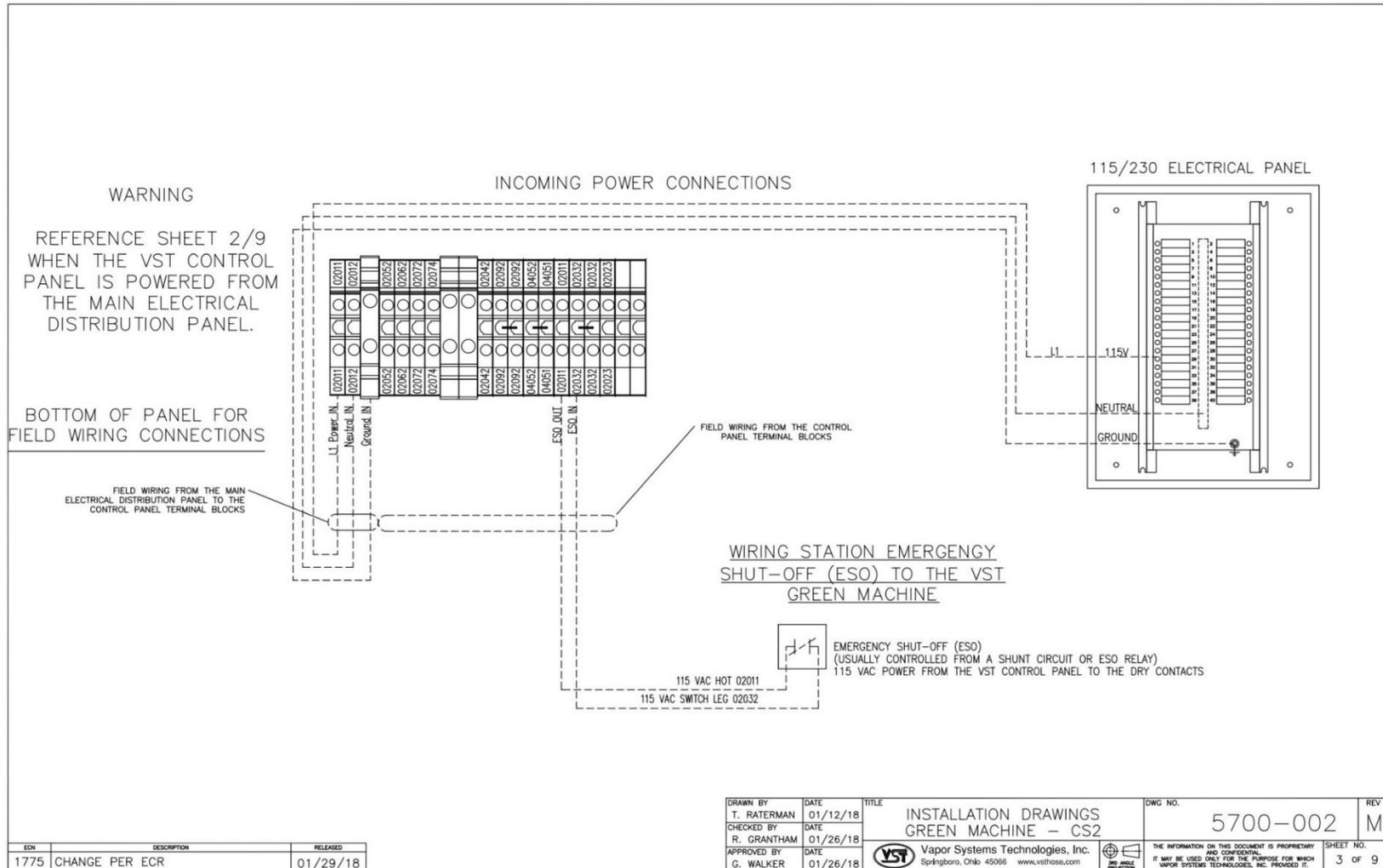


Figure 3-5: The Control Panel Power and ESO Connections Option 1

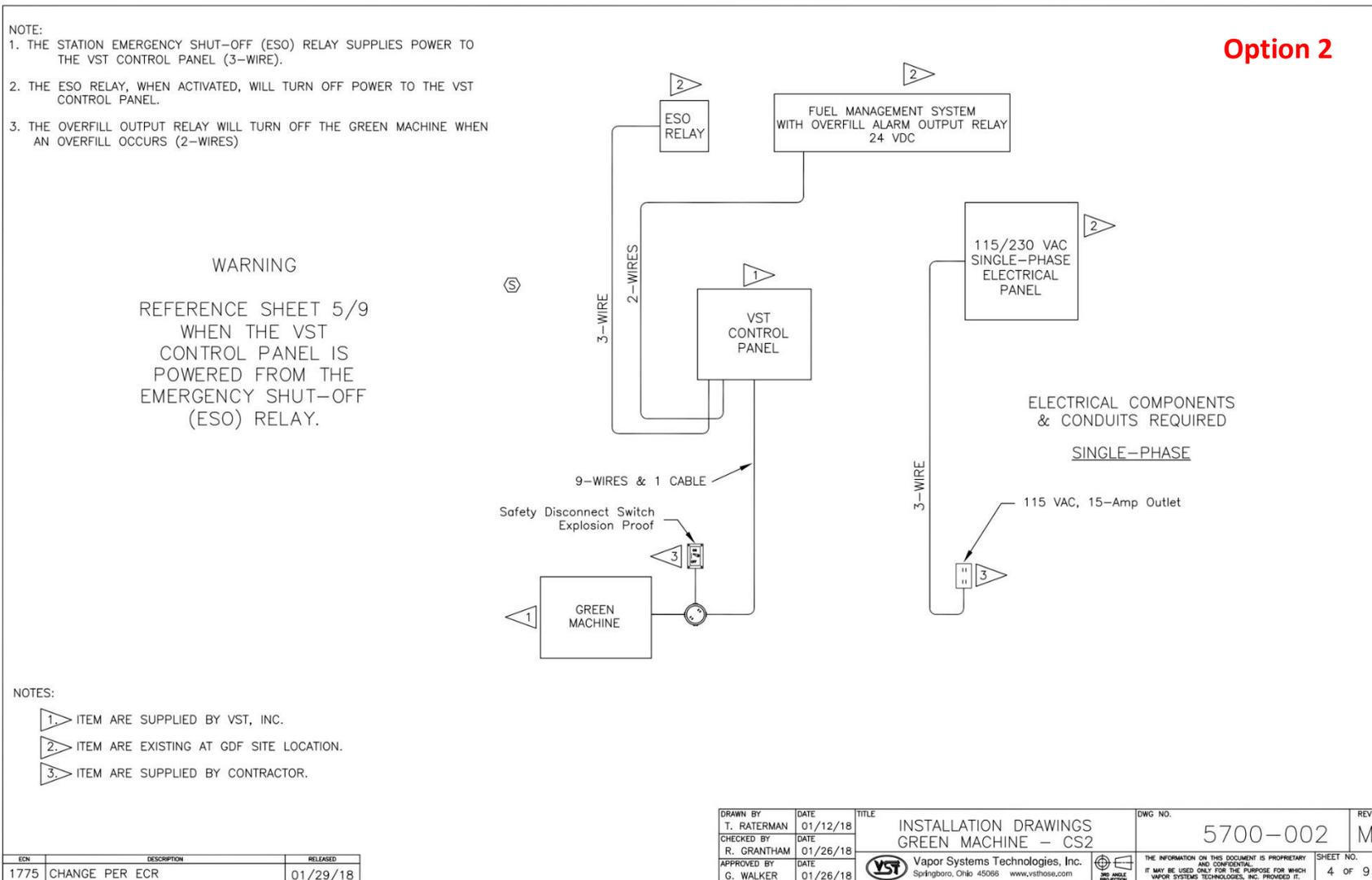


Figure 3-6: The GREEN MACHINE Installation Overview Option 2



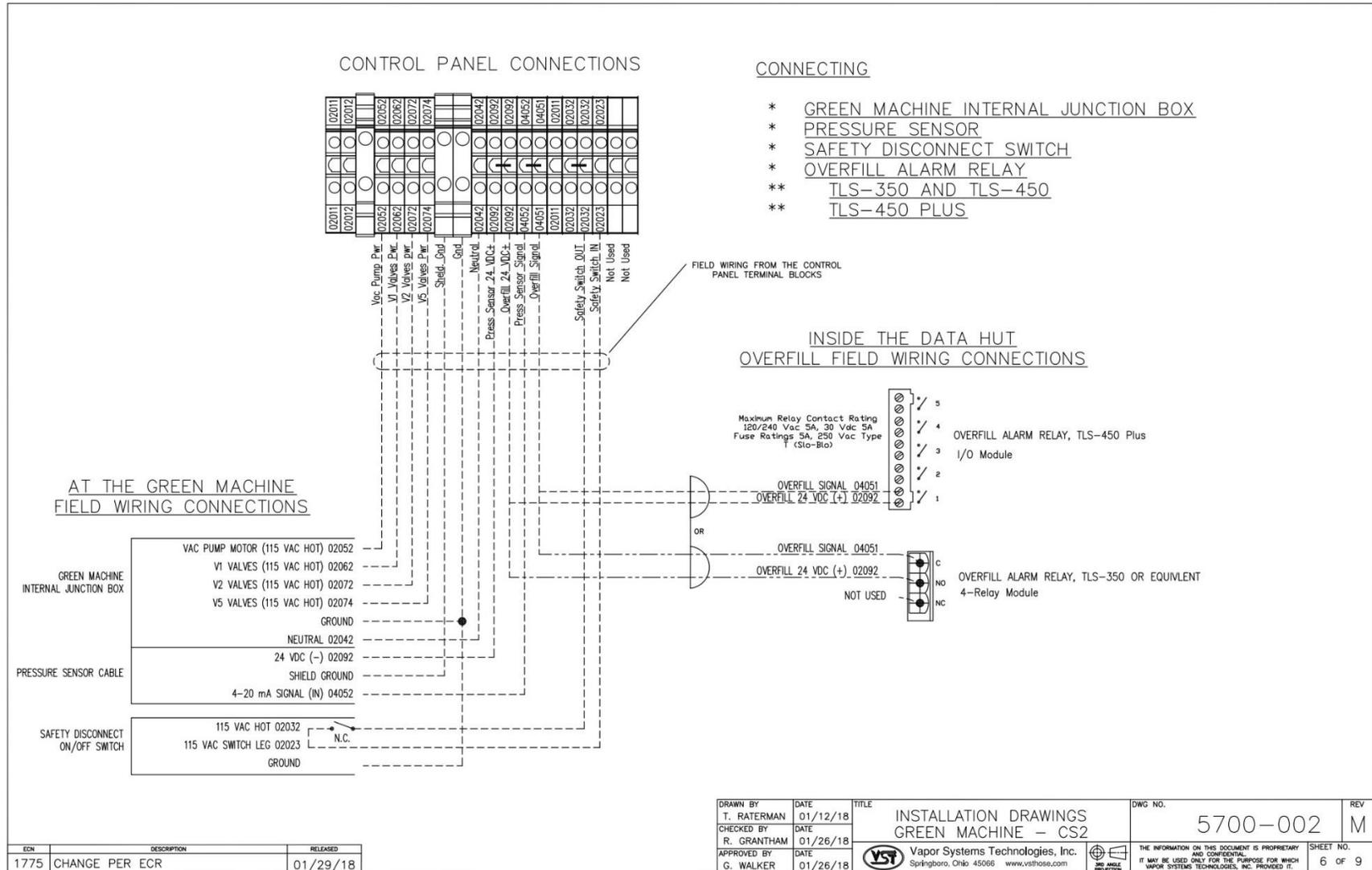


Figure 3-8: The VST Control Panel Field Wiring

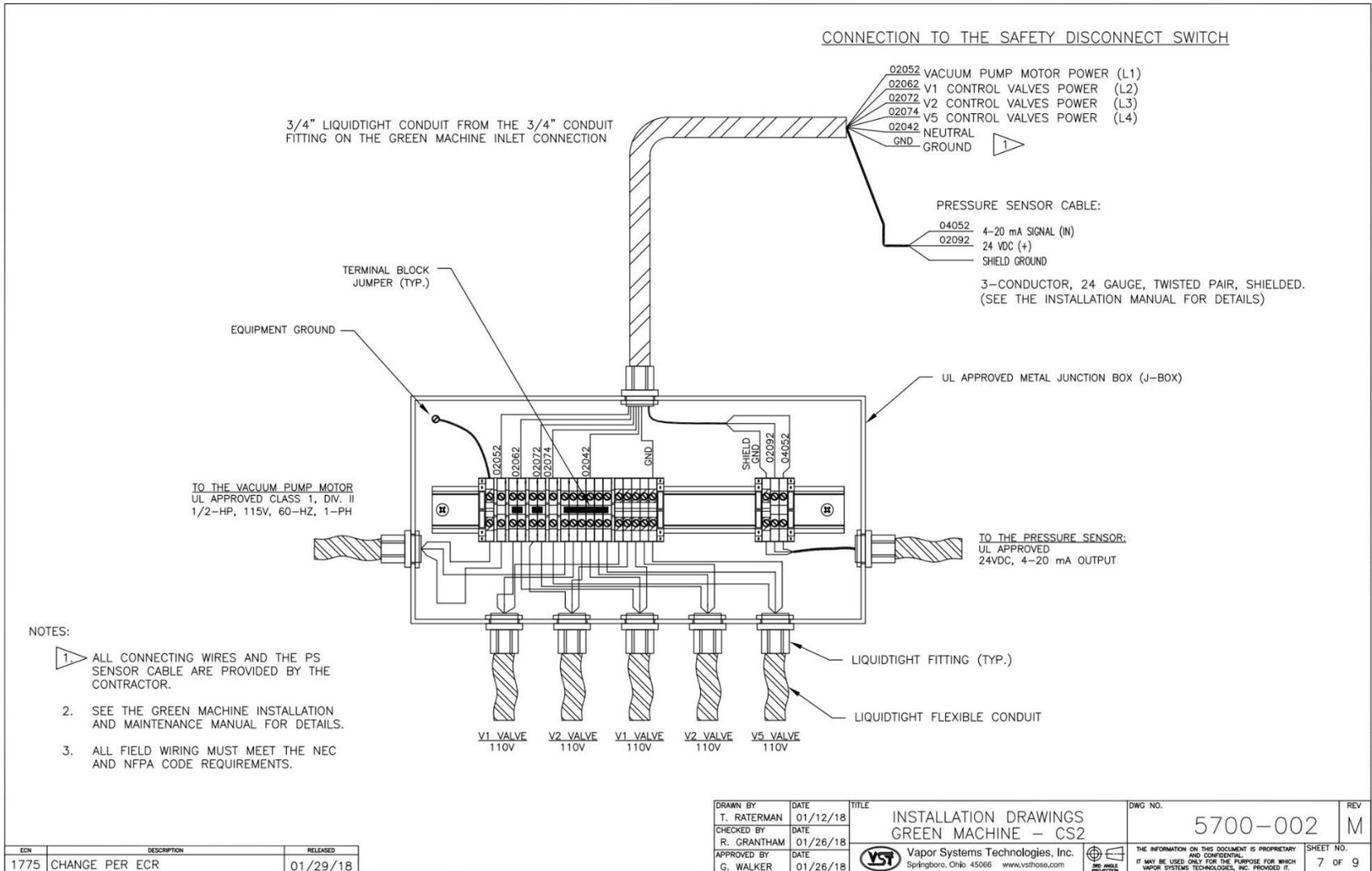


Figure 3-9: GREEN MACHINE Internal Junction Box Field Wiring

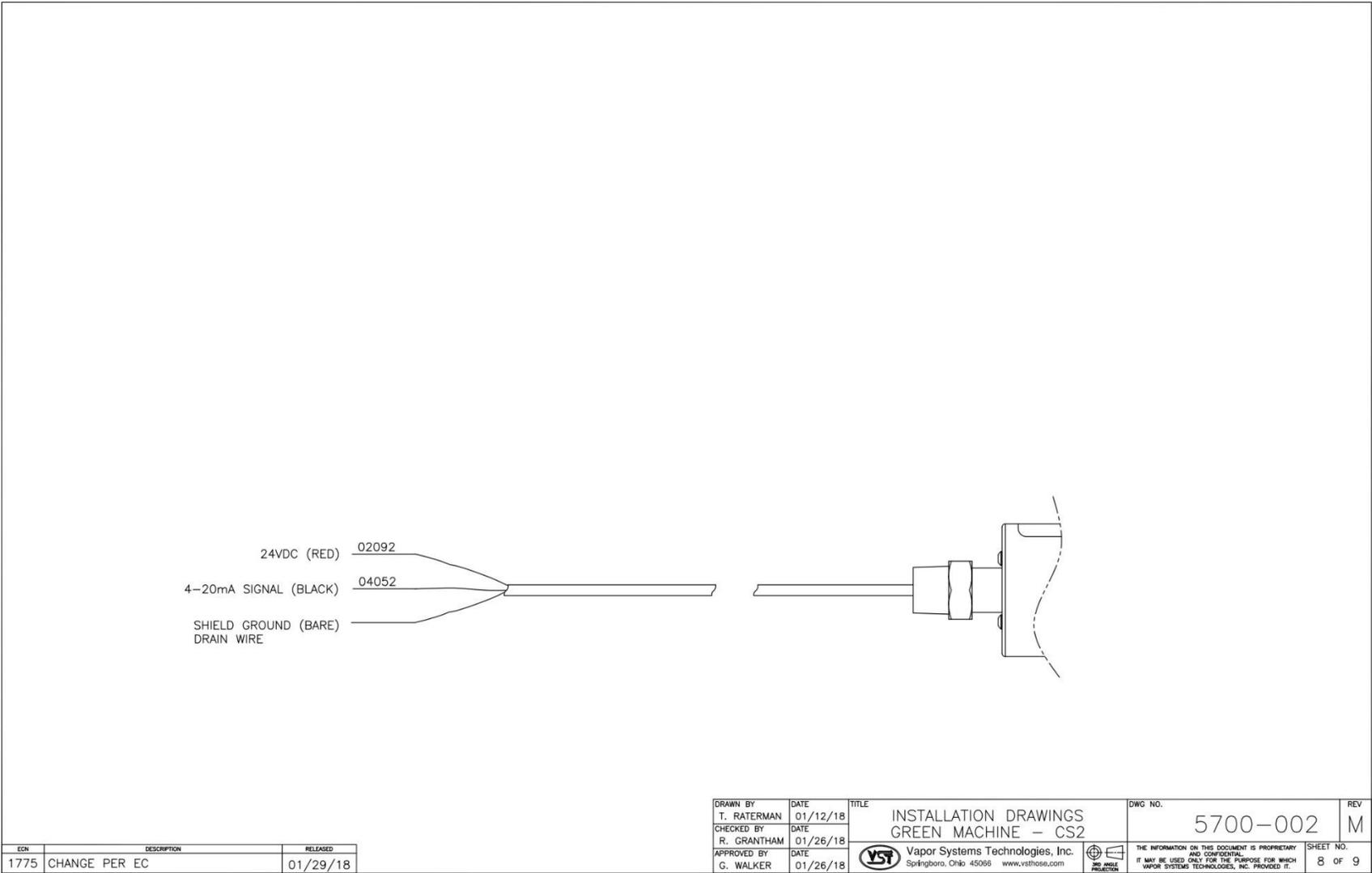


Figure 3-10: Pressure Sensor Wiring Diagram

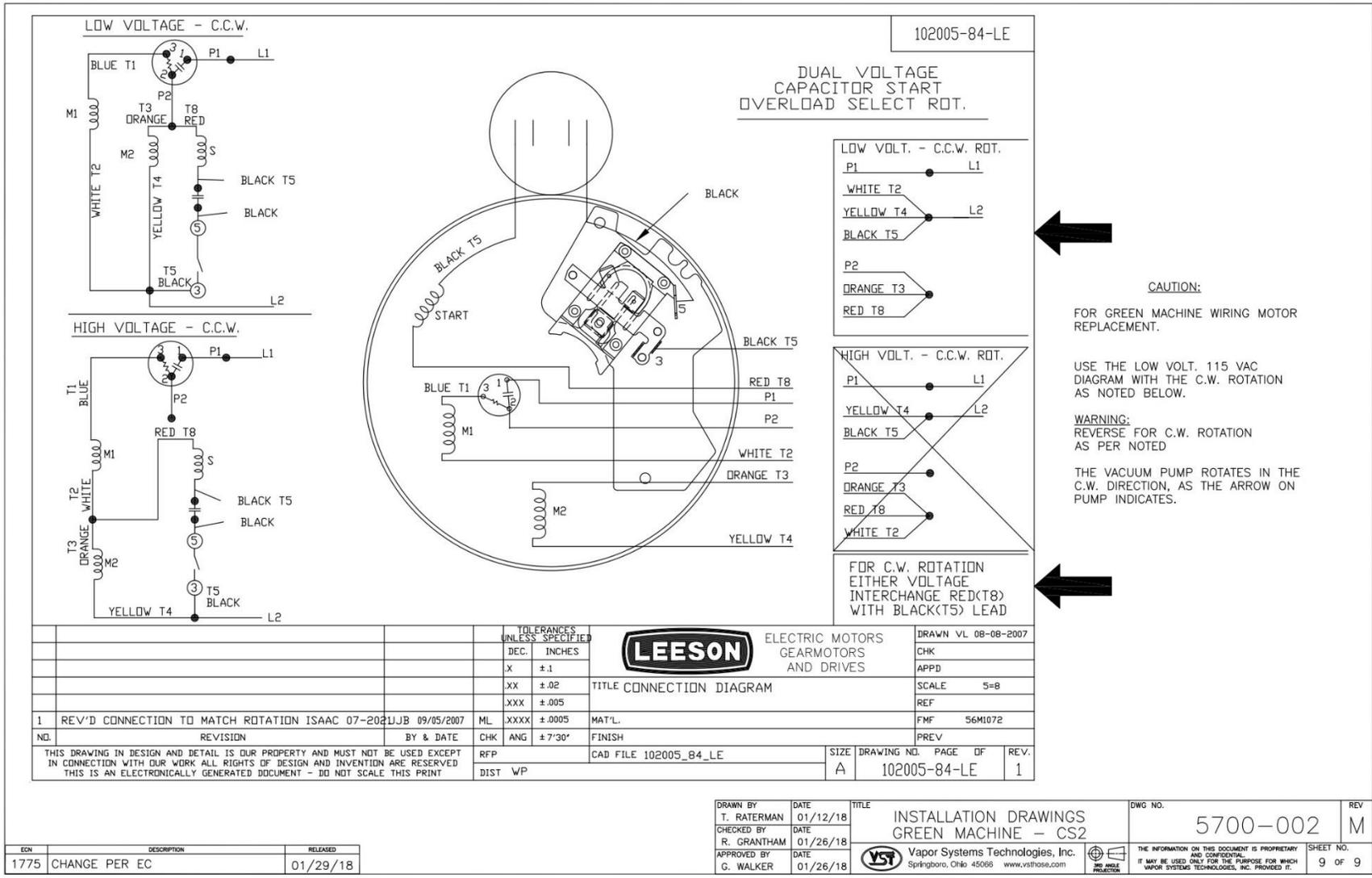


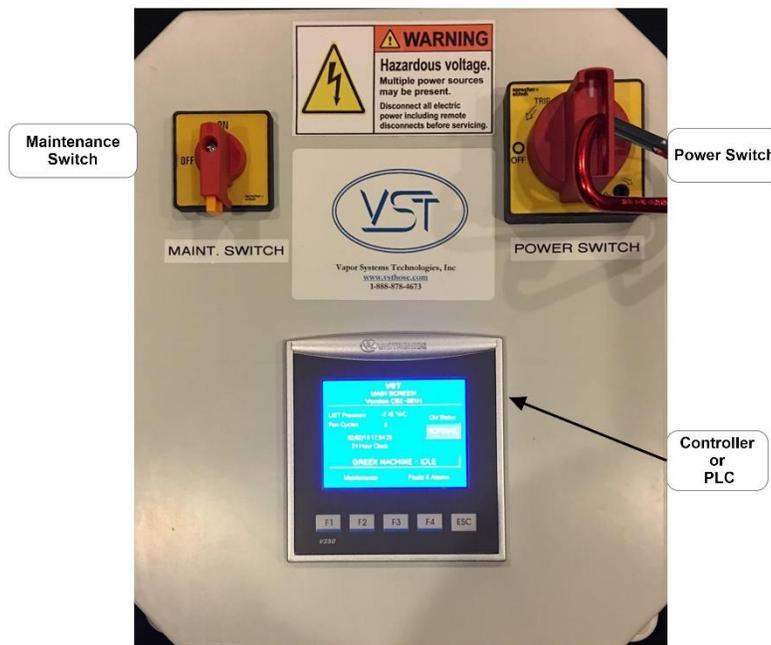
Figure 3-11: Vacuum Pump Motor Wiring Diagram



# Chapter 4: Control Panel

## 4 VST Control Panel Overview

- The VST Control Panel is designed to manage the operations of the GREEN MACHINE based on UST vapor pressure. **Figure 4-1** shows the front of the Control Panel with the following items:
  - **The VST Control Panel is what controls the GREEN MACHINE.**
    - The GREEN MACHINE will turn ON if the UST pressure is above 0.20 IWC.
    - The GREEN MACHINE will operate until the UST pressure falls below 0.20 IWC.
  - **The Power Switch (Lockable):**
    - Provides a means to disconnect ALL power from the VST Control Panel and ALL power to the GREEN MACHINE.
    - The Power Switch can be locked in the OPEN or CLOSED position. (Use lock-out/tag-out procedures.)
  - **The Maintenance Switch (Lockable)**
    - Turning the Maint. Switch OFF will disconnect ALL power from the GREEN MACHINE.
    - Turning the Maint. Switch OFF will keep power ON to the VST Control Panel and to the GREEN MACHINE Controller.
    - Turn the Maint. Switch ON for normal GREEN MACHINE Operation.



NA GM CS2 Control Panel, 04-24-2018

Figure 4-1: VST US Control Panel, Front View



## 4.1 Main Screen Overview

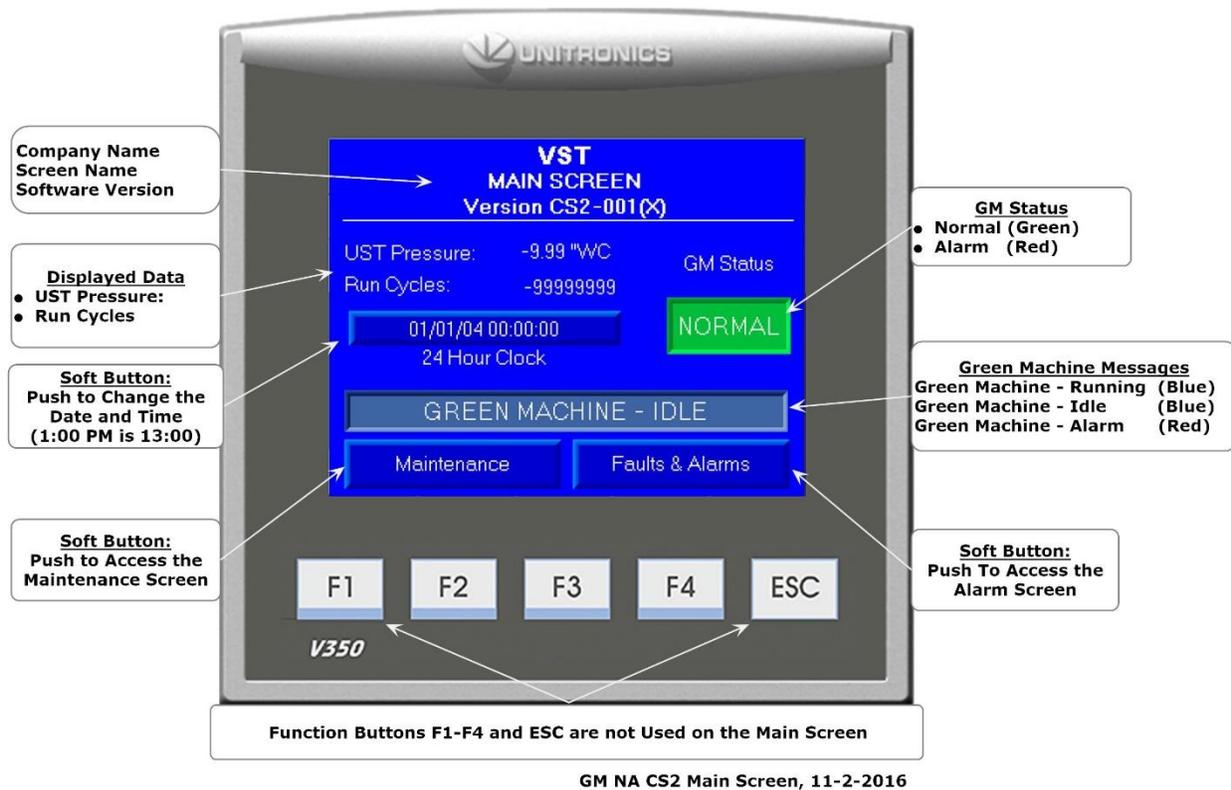


Figure 4-2: Main Screen

- The Control Panel PLC will always power up in the Main Screen. **See Figure 4-2.**
- The GREEN MACHINE will always be in the Normal Operating mode when the Main Screen is showing on the PLC, unless there is an Alarm Condition.
- GM Status:
  - Normal (Green Box) indicates the GREEN MACHINE is operating normally (no active Alarms).
  - Alarm (Red Box) indicates an Alarm is active.
- Date and Time:
  - Push the Date and Time soft button to change the Date and Time.
- Maintenance Screen and an Alarm Screen:
  - Push the Maintenance Screen soft button to access the Maintenance Screen.
  - A password (878) is required to access the Maintenance Screen.
  - Push the Alarm Screen soft button to access the Alarm Screen.



GREEN MACHINE Messages:	
GREEN MACHINE – Running:	Due to the UST pressure being greater than 0.20 IWC (Blue Text Box).
GREEN MACHINE – Idle:	Due to the UST pressure being less than 0.20 IWC (Blue Text Box).
GREEN MACHINE – Alarm:	Go to the Alarm Screen to identify the Alarm: An Alarm has activated. (Red Text Box) See the Operator Instruction Sheet for directions.
Displayed Data:	
UST Pressure (IWC):	Displays the UST pressure in real-time.
Run Cycles:	Displays the number of GREEN MACHINE completed cycles.
Date and Time	Date (MM/DD/YY) and 24-Hour Clock (HH:MM:SS).

#### 4.2 Maintenance Screen Overview

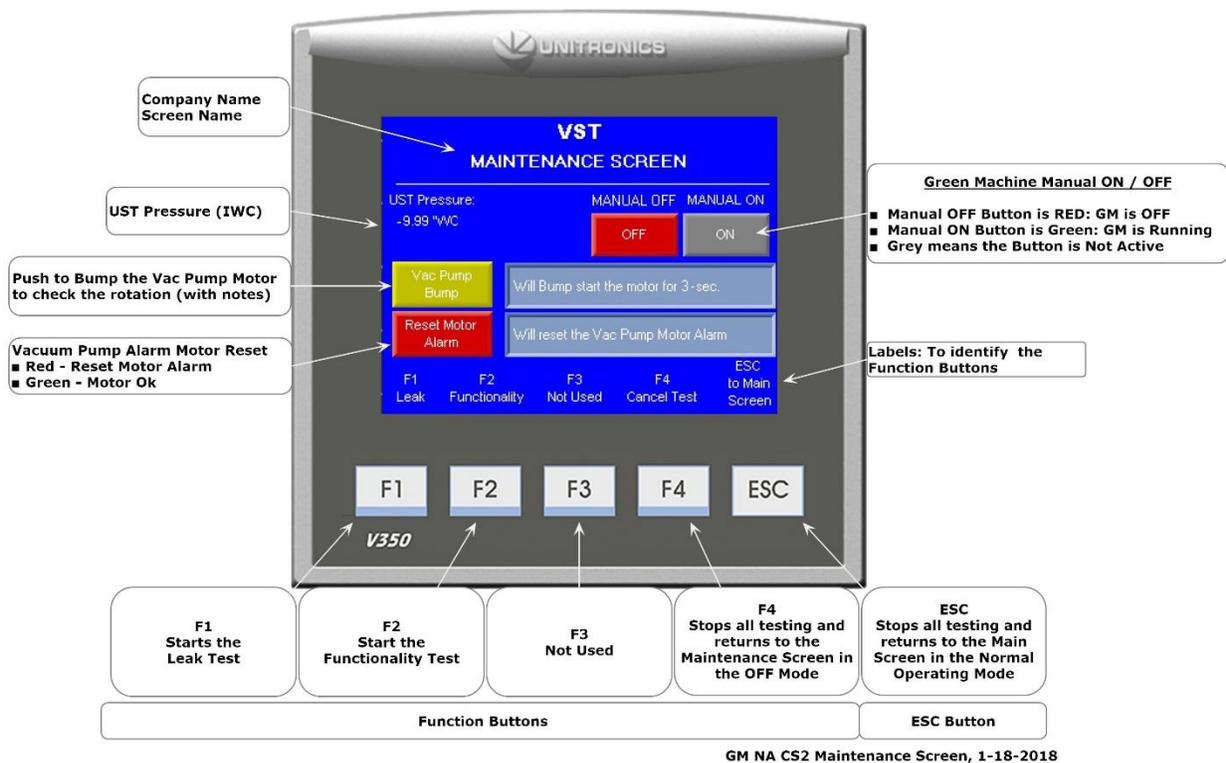


Figure 4-3: Maintenance Screen Overview



Maintenance Screen, continued...

- When the Maintenance Screen is shown, the GREEN MACHINE will always be in the OFF mode (unless the Manual ON button is pushed or testing is being conducted).  
**See Figure 4-3.**
- The UST Pressure is displayed as Inches of Water (IWC).
- The GREEN MACHINE can be placed in the Manual ON or Manual OFF mode only in the Maintenance Screen.
  - This feature is used when conducting maintenance on the GREEN MACHINE.
- Vac Pump Bump is used to check the Vacuum Pump motor rotation during start-up or after performing maintenance on the Vacuum Pump motor.
- The Reset Motor Alarm is used when the Vacuum Pump is in Alarm.
- Function Button labels are shown at the bottom of the screen.
- The F1, F2, F3, F4 Function buttons and the ESC button are accessible
  - F1: Start a Leak Test
  - F2: Start a Functionality Test
  - F3: NOT USED
  - F4: Stops all testing and returns to the Maintenance Screen in the OFF Mode.
- Pushing the ESC button stops all testing and returns to the Main Screen to the Normal Operating Mode.



### 4.3 Alarm Screen Overview

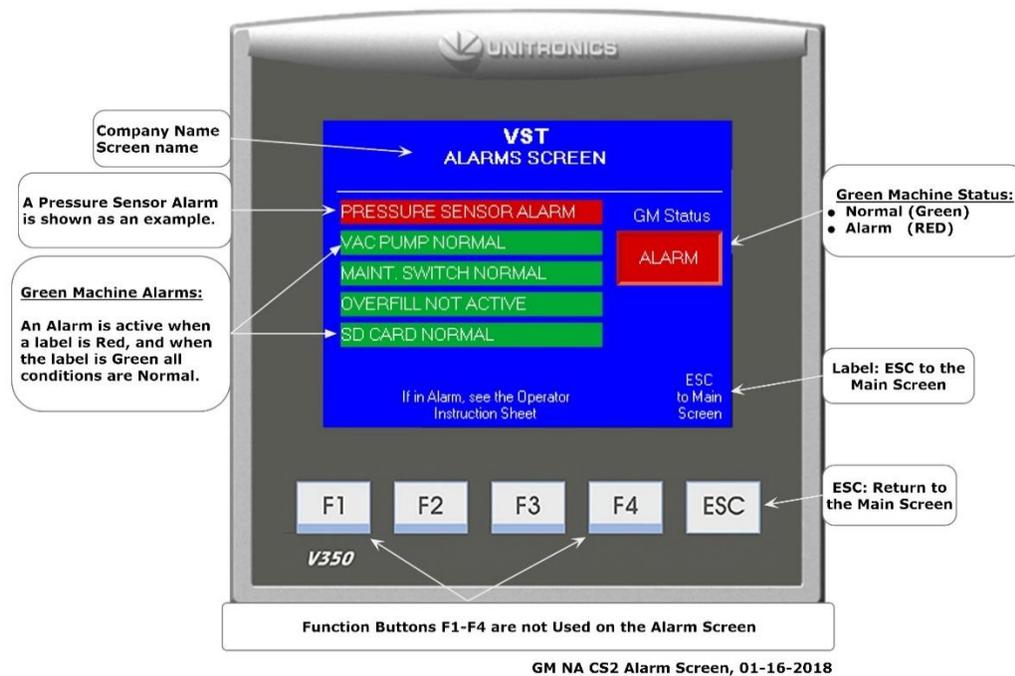


Figure 4-4: Pressure Sensor Alarm shown on the Alarm Screen

#### The Alarm Screen shows the following - See Figure 4-4:

- **GM Status**
  - Normal (Green Box) indicates the GREEN MACHINE is operating normally (no active Alarms).
  - Alarm (Red Box) indicates an Alarm is active. When an Alarm is active, see Chapter 10, the Operator Instruction Sheet, for directions.
- **Pressure Sensor Alarm:**
  - An Alarm will occur:
    - When the Pressure Sensor is not connected to the Control Panel.
    - When the Pressure Sensor is not wired properly at the Control Panel or at the GREEN MACHINE Internal Junction Box.
    - The GREEN MACHINE will NOT operate during this Alarm.
- **Vacuum Pump Alarm:**
  - An Alarm will occur:
    - When there is a problem with the Vacuum Pump, motor, or circuit.
    - The GREEN MACHINE will NOT operate during this Alarm.



Alarm Screen, continued...

- **Maintenance Switch Alarm:**
  - The Maintenance Switch is used when we want power to the VST Control Panel, but do not want the GREEN MACHINE to operate.
  - The GREEN MACHINE will not operate during this alarm.
  - The Maintenance Switch Alarm will occur:
    - When the Maintenance Switch is turned OFF, the GREEN MACHINE will not operate and the switch will show as an active alarm.
    - To remove the Maintenance Switch Alarm, turn the switch to ON.
  
- **Overfill Alarm:**
  - An Alarm will occur:
    - Whenever there is a UST gasoline overfill at the station, the VST Control Panel is configured to alarm.
    - If an overfill alarm activates while a test is running:
      - The test will terminate.
      - The Alarm will display RED, OVERFILL ACTIVE.
    - The GREEN MACHINE will NOT operate during this Alarm.
  
- **SD Micro Card Alarm:**
  - An Alarm will occur:
    - If the card is not installed or installed incorrectly.
    - After the card is installed, the Alarm will clear and Normal (Green).
    - The GREEN MACHINE will operate during this Alarm.



# Chapter 5: OPEN: NO CONTENT

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# Chapter 6: Testing & Start-Up

## 6 Post-Installation GREEN MACHINE Testing & Start Up

### 6.1 VST Control Panel Initial Start-Up Power:

When the power is turned ON to the VST Control Panel, the Main Screen will show on the PLC with the label **GM DISABLED – ENTER CODE**. See **Figure 6-1**. The CODE was initiated to prevent the electrical contractor from starting the GREEN MACHINE before the Start-Up was completed. The Start-Up can be completed with the GM DISABLED. The CODE to the VST Control Panel must be entered before the GREEN MACHINE can become operational. The CODE will be supplied to the Start-Up Contractor via e-mail after Appendix B is submitted online.

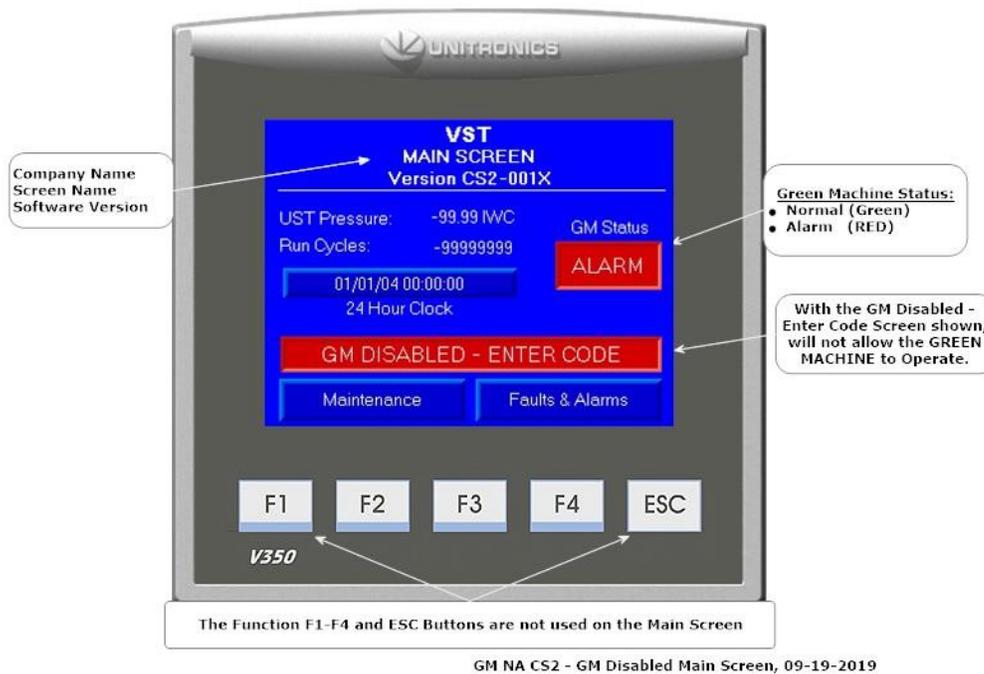


Figure 6-1: Main Screen with the GM DISABLED – ENTER CODE



## 6.2 Before beginning the Testing and Start-Up procedures

Follow the steps below to prepare the GREEN MACHINE and VST Control Panel for Testing & Start-Up

STEPS	DESCRIPTION
1.	Unlock the hasps and remove the cover on the GREEN MACHINE.
2.	Close the 3-way valve below the Pressure Sensor (the handle is horizontal).
3.	Close the three (3) ball valves between the GREEN MACHINE and the vent risers. <b>Reference Figure 6-2.</b>
4.	Remove the caps from the 3 tees. <b>Reference Figure 6-2.</b>
5.	Turn ON the GREEN MACHINE breaker at the Main Distribution Panel OR power is provided by the ESO Relay.
6.	Turn the Power Switch to the “ON” position located on the front of the Control Panel.
7.	At the PLC Main Screen, push the Maintenance Screen button to access the Password Screen.
8.	Enter 878 at the Password Screen to access the Maintenance Screen. (The GREEN MACHINE will now be in the Manual OFF mode.)
9.	Make sure the Maintenance Switch is ON at the VST Control Panel. (The GREEN MACHINE cannot operate in the Automatic Mode when the Maintenance Screen is showing regardless of the UST pressure.)

## 6.3 Post Installation Start-Up Tests

During post-installation testing, the GREEN MACHINE will use outside air (no gasoline vapor from the USTs) to conduct these tests.

**The following tests must be conducted in the order shown below to avoid damage to the equipment.**

<b>6.4</b>	Bump Test
<b>6.5</b>	Functionality Test
<b>6.6</b>	Programming the Fuel Management System for the GREEN MACHINE Overfill Alarm Relay
<b>6.7</b>	Test the Overfill Alarm on the GREEN MACHINE VST Control Panel:
	<b>6.7.1</b> The TLS-350 Overfill Alarm Connection
	<b>6.7.2</b> The TLS-450 Overfill Alarm Connection
	<b>6.7.3</b> The TLS-450 PLUS Overfill Alarm Connection
<b>6.8</b>	Changing the Date and Time Procedure
<b>6.9</b>	Submitting Appendix B and Verification CODE Retrieval

The final step in the installation process is to start up the GREEN MACHINE and get it field commission ready. This final commissioning process requires a verification code that will be entered into the PLC.



#### 6.4 How to get a verification code:

STEPS	DESCRIPTION
1.	Go to <a href="http://www.vsthose.com">www.vsthose.com</a> .
2.	Click on VST Education & Training (at the bottom of the webpage)
3.	Under “US GREEN MACHINE,” Click on “Supporting Documents and Instructional Videos.”
4.	Click on “Start-Up / Commissioning Contractor.”
<b>Note: If you have not been trained to conduct Appendix, Click on “Appendix B – Training Video”, then go to Step 5.</b>	
5.	Click on “Appendix B - Start-Up Contractor Check-Out Form.”
6.	Fill out Appendix B with the required photos then click on Submit.
7.	Receive an email from VST with the verification code and a copy of the filled-out Appendix B.

**These items are to be checked in Appendix B as they are completed.**

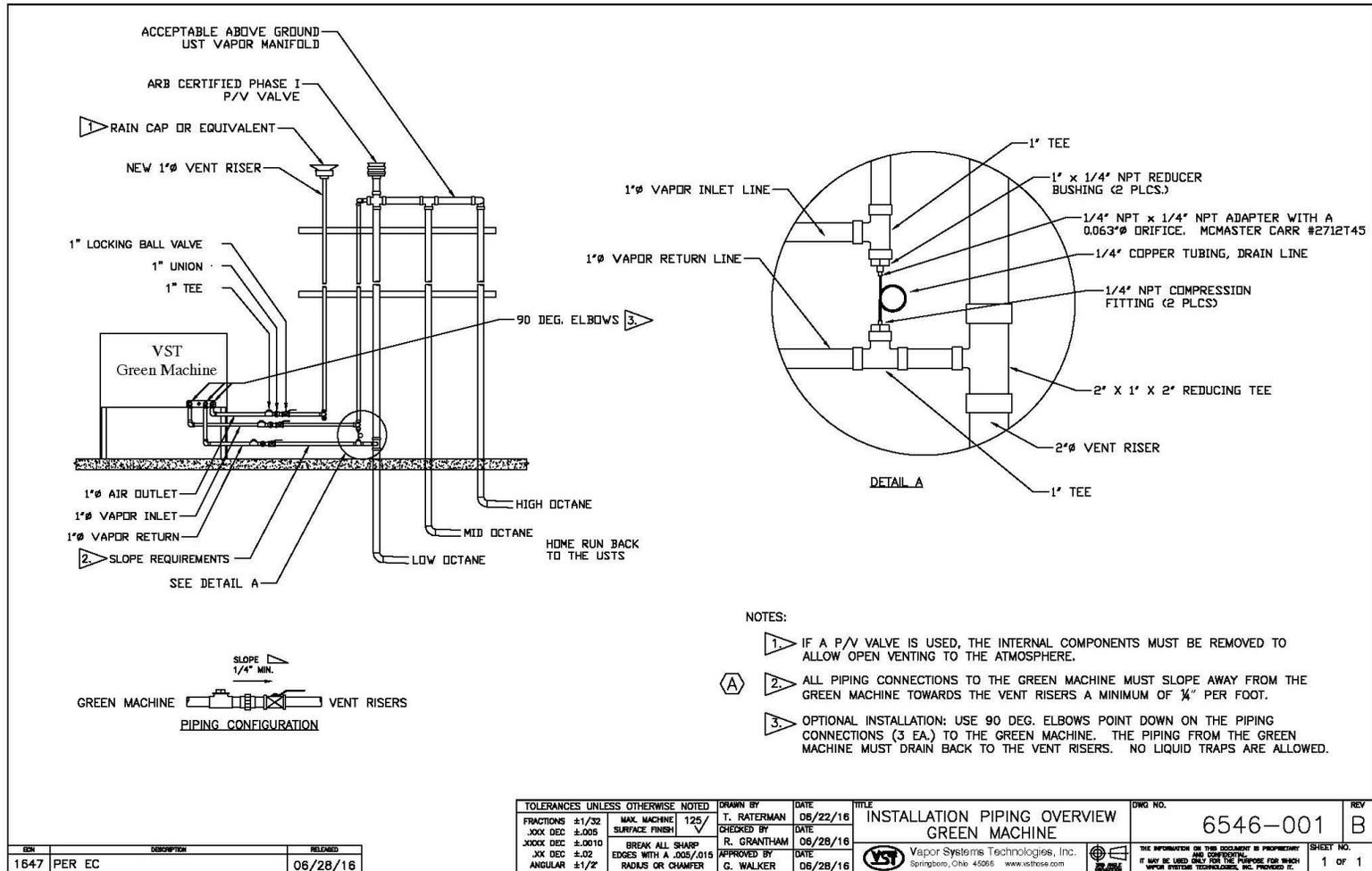


Figure 6-2: Vapor Piping Overview



## 6.5 Bump Test

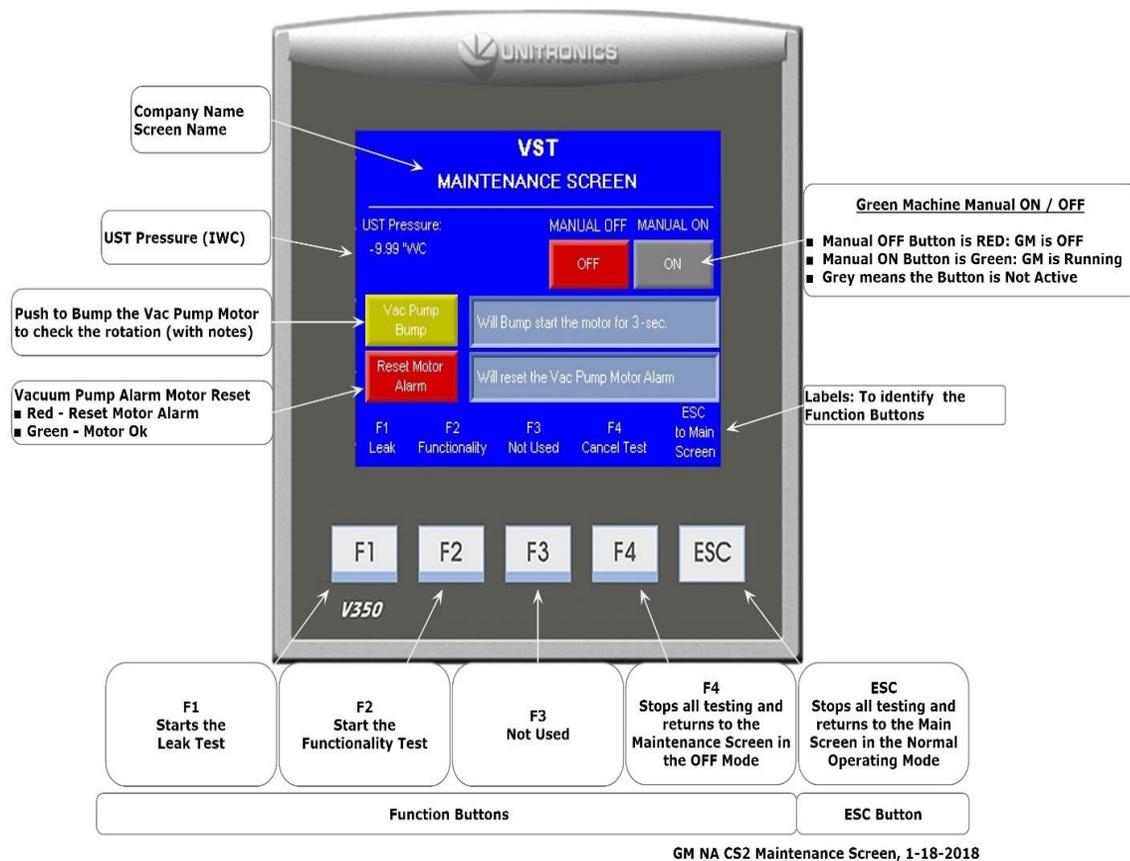


Figure 6-3: Maintenance Screen

### 6.5.1 Purpose of the Bump Test

The purpose of the Bump Test is to ensure that the Vacuum Pump Motor is rotating in the correct direction when the GREEN MACHINE is running.

- Damage will occur to the Vacuum Pump if it rotates in the wrong direction.

### 6.5.2 Preparation for the Bump Test

1. Make sure the Maintenance Screen is showing on the PLC. **See Figure 6-3.** (The GREEN MACHINE is now in the Manual OFF mode and will not operate.)

If the PLC is not in the Maintenance Screen: At the Main Screen, push the Maintenance Screen button to access the Password Screen then enter the password to access the Maintenance Screen: Password is 878.

2. One person needs to be at the VST Control Panel to begin the Bump Test.
3. A second person needs to be at the GREEN MACHINE when the Motor Bump Test begins.
4. After the test is started, the motor will rotate for 5-seconds, which will allow the person at the GREEN MACHINE to check the rotation of the motor.



### 6.5.3 Bump Test Procedure

1. At the Maintenance Screen, push the Vac Pump Bump button to go to the Bump Motor Confirmation Screen. **See Figure 6-3.**
2. At the Bump Motor Confirmation Screen, push the red Confirm Motor Bump button to start the Vacuum Pump motor rotation. Then cancel the Bump Motor; push the green button to return to the previous screen. **See Figure 6-4.**
3. The Vacuum Pump Motor will rotate for 5-seconds, which is just enough time for the second person at the GREEN MACHINE to check the motor rotation. The motor rotation is indicated by a directional arrow on the pump.
4. If the motor is rotating in the correct direction, the test is completed.

If the motor is not rotating in the correct direction, switch two of the motor wires, T5 and T8, at the Vacuum Pump Motor Junction Box. **See Figure 6-5.**

5. After changing the motor leads, run the Bump Test again to make sure the Vacuum Pump Motor is rotating in the correct direction.
6. When the test is completed, the PLC will show the Main Screen.

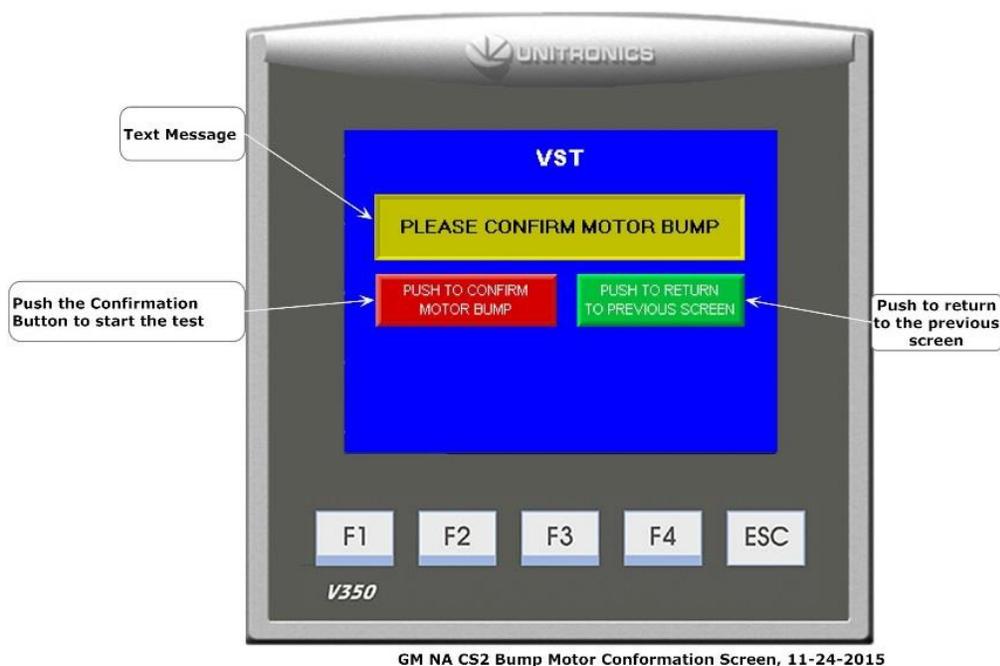
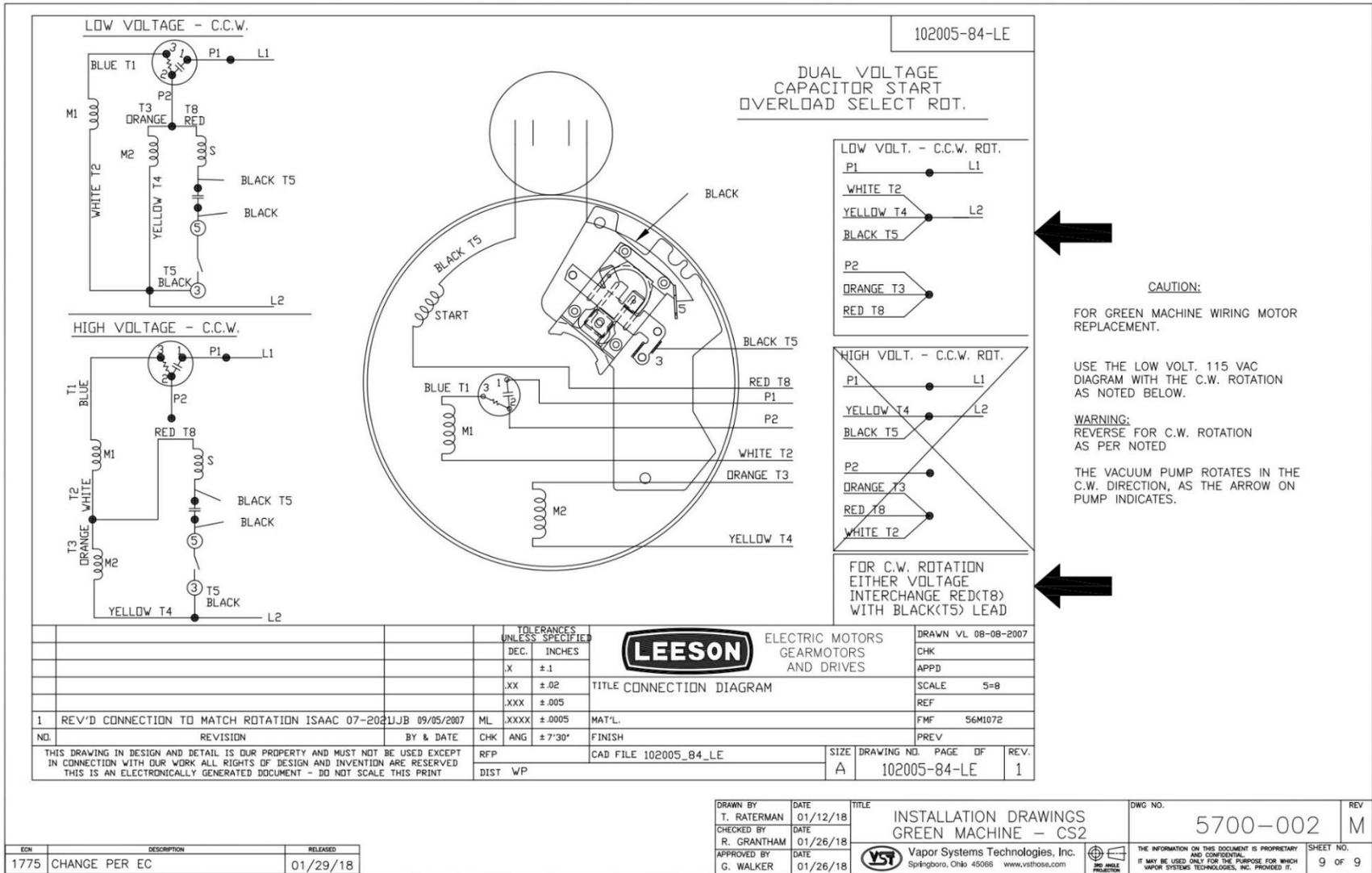


Figure 6-4: Bump Confirmation Screen



SCALE: N/A  
TITLE: CS2  
FILENAME: 5700-002

Figure 6-5: Vacuum Pump Motor Wiring Diagram



## 6.6 Functionality Test

### 6.6.1 The Purpose of the Functionality Test

The purpose of the Functionality Test is to verify that the Control Panel, Vacuum Pump, and the Control Valves are working properly.

### 6.6.2 Preparation for the Functionality Test

1. At the VST Control Panel, make sure the Maintenance Screen is showing on the PLC. **See Figure 6-6.** (The GREEN MACHINE is now in the Manual OFF mode and will not operate.)

If the PLC is not in the Maintenance Screen: At the Main Screen, push the Maintenance Screen button to access the Password Screen, then enter the password to access the Maintenance Screen: Password is 878.

2. At the GREEN MACHINE, make sure the locks from the three ball valves have been removed, all three valves are closed, and the caps from the three tees have been removed. **See Figure 6-7.**
3. Unlock the hasp and remove the cover from the GREEN MACHINE.
4. Close the 3-way valve below the Pressure Sensor so the handle is turned HORIZONTAL (OFF or Closed). Leaving the valve ON or Open during this test may damage the Pressure Sensor.

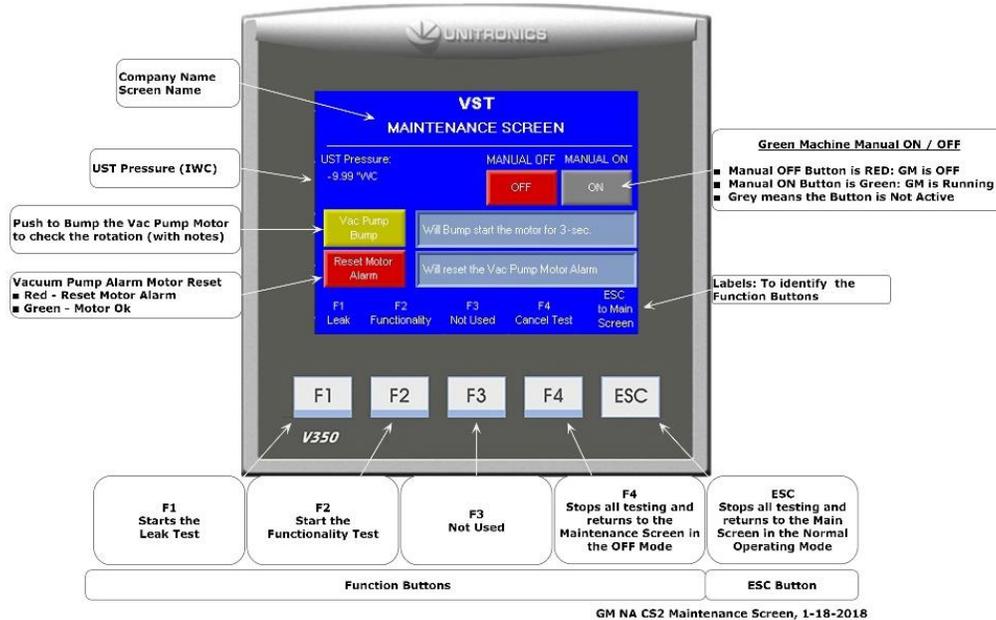


Figure 6-6: Maintenance Screen

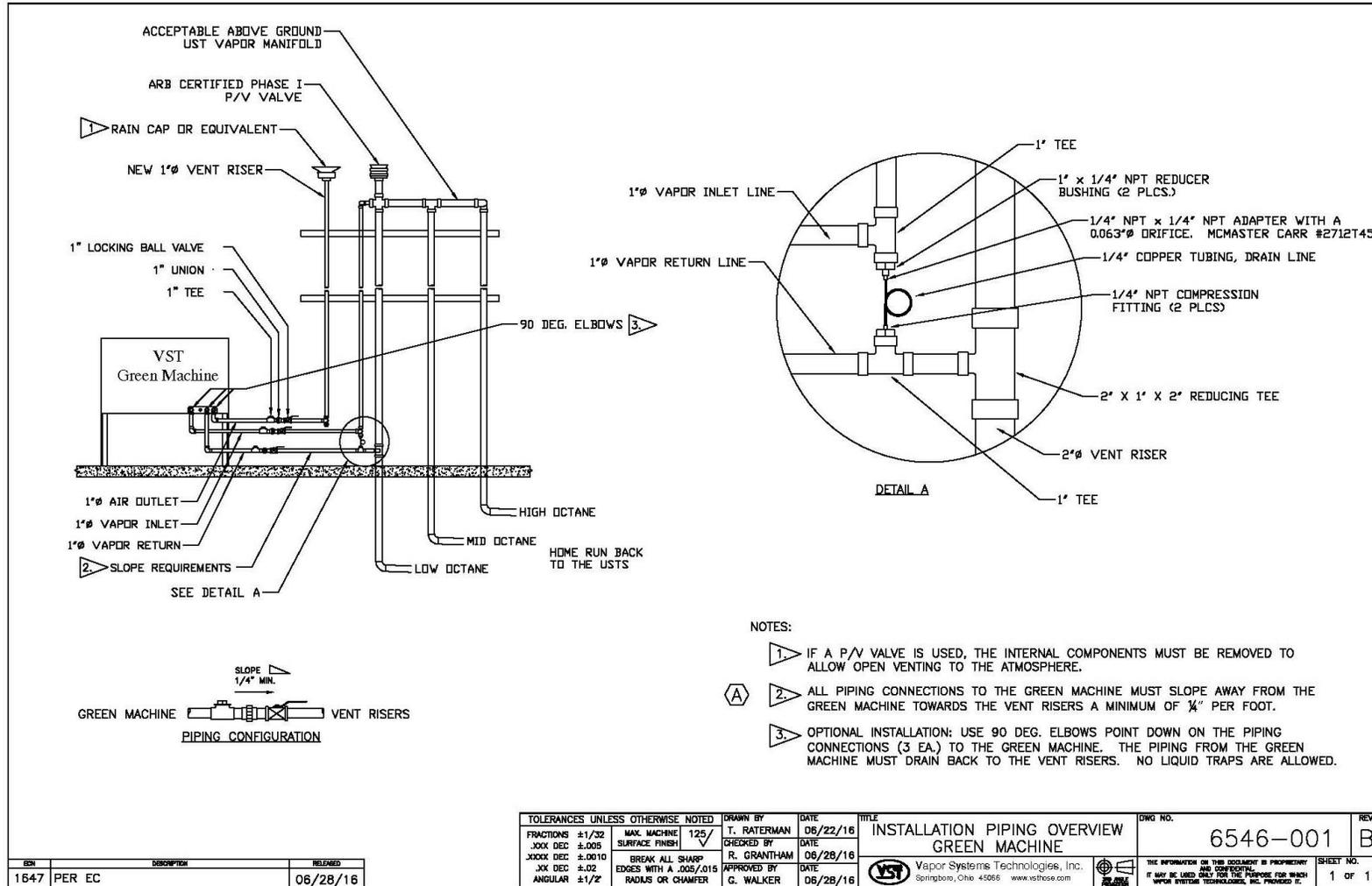


Figure 6-7: GREEN MACHINE Vapor Piping Layout



### 6.6.3 Functionality Test Procedures

1. Push the F2 button to access the Functionality Test Screen. **See Figure 6-8.**
2. To start the Functionality Test, push the Start Button.
3. Push the Confirm Functionality Test Button to confirm you would like to start the Functionality Test.  
**See Figure 6-9.**
4. The GREEN MACHINE will run for 60-seconds then purge for 60-seconds (this is one cycle).
5. The GREEN MACHINE will continue to cycle 5-times or until the F4 button is pushed to end the test.
  - There are 5-cycles to provide enough time to conduct the test.
  - Pushing the F4 button will return the system to the Maintenance Screen and the GREEN MACHINE will be in the OFF mode.
6. When the test has ended, the VST Control Panel PLC will display GREEN MACHINE OFF.
7. During the 60-second Run Cycle: **See Figure 6-10.**
  - Place your hand over the tee opening at the Vapor Inlet and feel for suction.
  - Next, place you hand over the tee opening at the Vapor Return and feel for zero airflow.
  - Next, place your hand over the tee opening at the Air Outlet and feel for air blowing.
8. During the Run Cycle:
  - 1) Suction at the Vapor inlet: NORMAL
  - 2) Air blowing out the Air Outlet: NORMAL
  - 3) No air blowing/suction at the Vapor Return: NORMAL
  - 4) All other blowing or suction conditions at each location, check the following items:
    - Make sure the Vacuum Pump is not in alarm. If so, see Chapter 8: Troubleshooting, Section 8.6.
    - Check the Control Valves to make sure they are all operational. See Chapter 8: Troubleshooting, Section 8.6.1, Step 5:
    - Make sure there is no debris in the valve seat. Clean the valves as shown in Section 7.5: Cleaning the Control Valves.
    - Make sure the flare nuts are tight. Check each 45-deg. flare nut to make sure they are snug but not over tightened.
9. During the 60-second Purge Cycle: **See Figure 6-10.**
  - After the Purge Cycle has begun, place your hand over the tee opening at the Vapor Return and feel for air blowing. The blowing air will reduce to zero flow soon after the Purge Cycle begins.
  - Next, place your hand over the tee opening at the Vapor Inlet and feel for zero airflow.
  - Next, place your hand over the tee opening at the Air Outlet and feel for zero airflow.



Functionality Test, continued...

10. During the Purge Cycle:

- 1) No air blowing/suction at the Vapor Inlet:       NORMAL
- 2) No air blowing/suction at the Air Outlet:       NORMAL
- 3) Momentary blowing at the Vapor Return:       NORMAL
- 4) All other blowing or suction condition at each location:
  - Make sure the Vacuum Pump is not in alarm. If so, see Chapter 8: Troubleshooting, Section 8.6.
  - Check the Control Valves to make sure they are all operational. See Chapter 8: Troubleshooting, Section 8.6.1, Step 5:
  - Make sure there is no debris in the valve seat. Clean the valves as shown in Section 7.5: Cleaning the Control Valves.
  - Make sure the flare nuts are tight. Check each 45-deg. flare nut to make sure they are snug but not over tightened.

11. After the Functionality Test has ended:

- The PLC will automatically go back to the Maintenance Screen and will remain in the OFF mode.
- Lock open the three ball valves between the GREEN MACHINE and the Vent Risers, and replace the caps on the three tees.
- **CAUTION: Make sure the 3-way valve below the Pressure Sensor is turned VERTICAL (ON or Open). Leaving the valve turned OFF at the Pressure Sensor will not allow the GREEN MACHINE to operate in the Normal Operating Mode.**
- At the PLC, push the ESC button to return to the Main Screen.

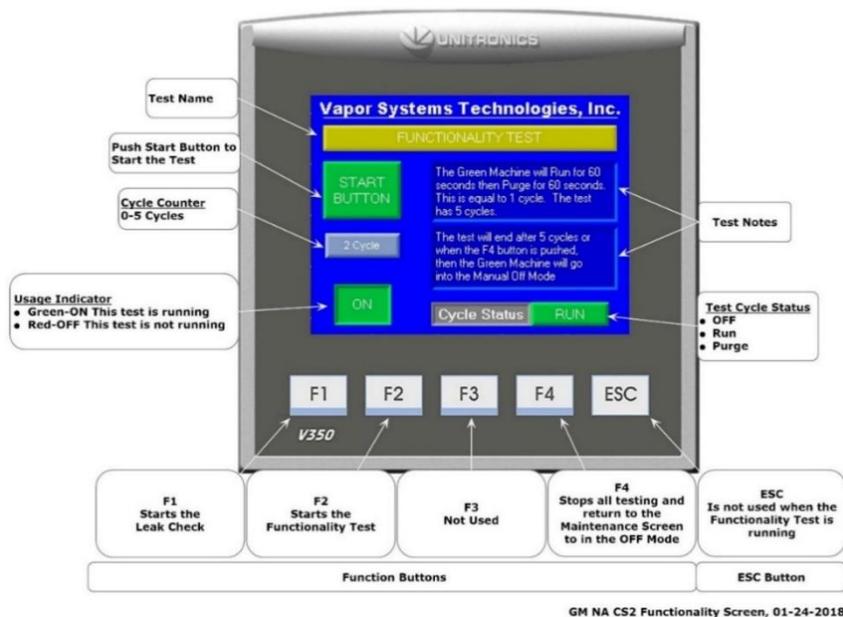
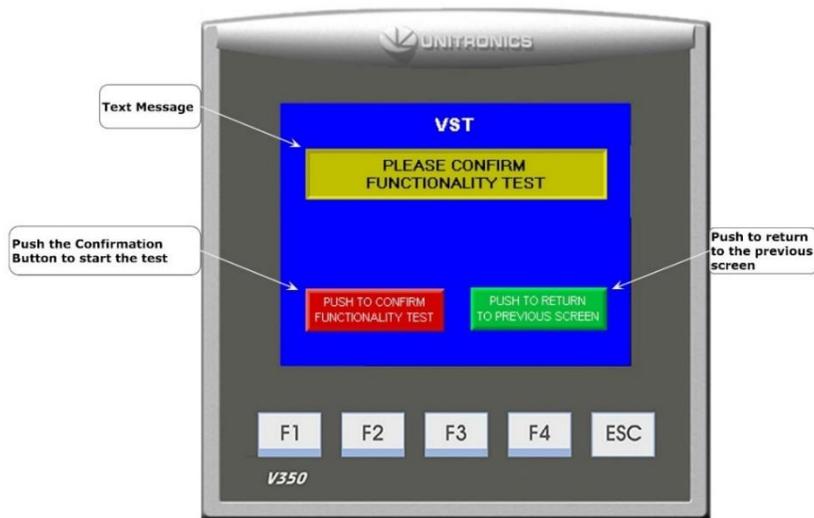


Figure 6-8: Functionality Test Screen



GM NA CS2 Functionality Conformation Screen, 7-14-2015

Figure 6-9: Functionality Test Confirmation Button

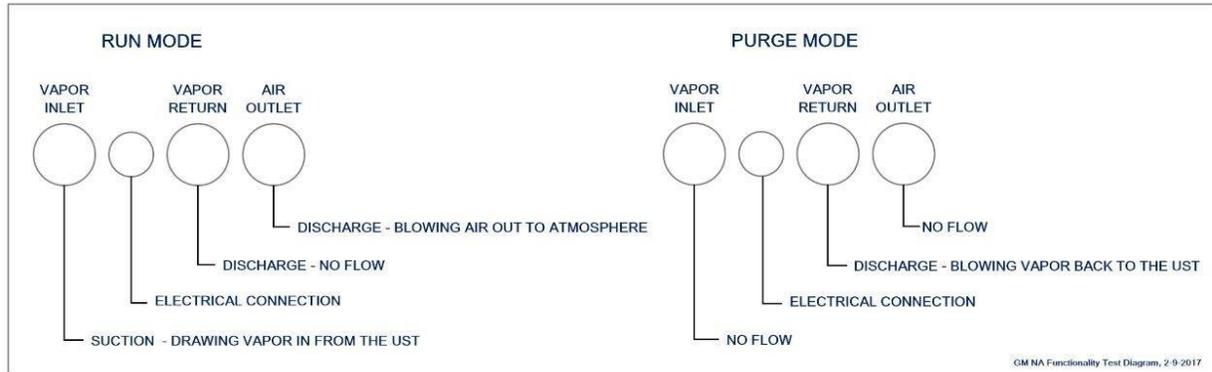


Figure 6-10: GREEN MACHINE Operation Diagram

## 6.7 Programming the Fuel Management System Overfill Alarm Relay for the GREEN MACHINE

### OVERFILL ALARM RELAY CIRCUIT

- The Electrical Contractor has installed the Overfill Alarm signal wiring from the VST Control Panel to the “Fuel Management System Overfill Alarm” output module.
  - The VST Control Panel supplies 24 VDC to the Overfill Alarm relay.
  - The Overfill Alarm output “dry” relay (N.O.) shuts down the GREEN MACHINE when a UST reaches the Overfill Level (90%) during a fuel drop.
  - Label the Overfill relay “GM Overfill Alarm.”
  - The wiring from the VST Control Panel to the Fuel Management System MUST be installed before the Start-Up of the GREEN MACHINE can be complete.
  - Reference Overfill terminal block wire numbers:
    - 24 VDC (+) – (Wire Number 02092)
    - 24 VDC (0) – (Wire Number 04051)



## 6.8 Testing the Overfill Alarm on the GREEN MACHINE VST Control Panel

### 6.8.1 TLS-350 Overfill Alarm Test

- This procedure will test the connection from the TLS-350 to the VST Control Panel.
- The VST Control Panel may or may not be wired/connected to the TLS-350 Overfill Alarm relay as outlined Chapter 3: Electrical Installation.
- When an Overfill occurs, the Overfill relay closes which completes a 24 VDC circuit to the VST Control Panel. The GREEN MACHINE will remain OFF two hours after the Overfill Alarm clears.

#### Procedures:

1. At the TLS-350, Press MODE until the screen reads SETUP MODE.
2. Press FUNCTION until the screen reads OUTPUT RELAY SETUP.
3. Press the PRINT button to print a list of output relays, then read the printout and identify the relay number associated with the OVERFILL for the GREEN MACHINE.
4. **Figure 6-11** shows the GREEN MACHINE OVERFILL relay as relay number 2.
5. Press MODE to return to ALL FUNCTIONS NORMAL screen.
6. At the ALL FUNCTIONS NORMAL screen, press FUNCTION until the screen reads TEST OUTPUT RELAYS.
7. Press the STEP button until the screen reads TEST OUTPUT RELAYS ENTER RELAY NUMBER 0.
8. Press the number on the keypad that corresponds to the relay assigned to the GREEN MACHINE output relay, then push ENTER.
9. The screen should read R X: GM OVERFILL PUSH ALARM/TEST KEY.
10. Press RED ALARM/TEST button to activate the GREEN MACHINE Overfill relay.
11. If the Overfill Alarm is active, the wiring of the Overfill Relay and the Overfill programming is correct. After two hours, the Overfill Alarm will clear.
12. If the Overfill Alarm is NOT active, contact the General Contractor or the electrical contractor to correct the wiring from the VST Control Panel to the TLS-350 Overfill relay, then conduct the test again until the test passes and the Overfill Alarm is active on the VST Control Panel PLC.
13. After the test is concluded, press the MODE button at the TLS-350 until the screen reads ALL FUNCTIONS NORMAL.
14. The Test has passed and is concluded. The GREEN MACHINE will remain OFF for two hours after the test is completed.



Figure 6-11: Output Relay Setup

### 6.8.2 TLS-450 Overfill Alarm Test

- The Overfill Relay and VST Control Panel Check is used to test the TLS-450 Overfill Relay as it is connected to the VST Control Panel. When the Overfill relay is active, the VST Control Panel will not allow the unit to operate.
- This test sets selected relays to INACTIVE for two seconds and then sets them to ACTIVE for two seconds. When the test is complete the relays are automatically reset to their original state.

#### Procedures:

1. At the TLS-450 Home Screen, select the Diagnostic button to access the Diagnostic Screen.
2. At the TLS-450 Diagnostic Home Screen, select the Relay and Input button to access the Relay & Input Screen.
3. At the Relay & Input Screen, select the Test Relay to conduct the Sequential Testing Procedure.
4. Check the box for the Overfill relay connected to the VST Control Panel.
5. For the selected relay the system will perform the following sequence:
  - 5.1 Save State: The current relay state will be saved before a test is run on the specific relay.
  - 5.2 Highlight Relay: For the relay being tested, the screen will highlight that relay during its test.



TLS 450 Overfill Alarm Test, continued...

- 5.3 Deactivate Relay: The relay being tested will be put in an Active state for two seconds and the status of the relay on the screen will be set to Sw Test.
- 5.4 Activate Relay: The relay being tested will be put in an Active state for two seconds and the status of the relay on the screen will be set to Sw Test.
- 5.5 Reset Relay: Once the test is complete, the relay will be returned to its original status which was saved at the beginning of the test and will no longer be highlighted.
- 5.6 Test Completion: Touch the selected Overfill Relay to deselect it or close the screen.
6. After the test is complete, check the VST Control Panel PLC to make sure the Overfill Alarm is active.
7. If the Overfill Alarm is active, the wiring of the Overfill Relay and the Overfill programming is correct. After two hours, the Overfill Alarm will clear.
8. If the Overfill Alarm is NOT active, contact the General Contractor or the electrical contractor to correct the wiring from the VST Control Panel to the TLS-450 Overfill relay, then conduct the test again until the test passes and the Overfill Alarm is active on the VST Control Panel PLC.

### 6.8.3 TLS 450 Plus Overfill Alarm Test

**Procedures:**

1. At the TLS-450 Plus Home Screen, select the Diagnostic button to access the Diagnostic Screen.
2. At the Diagnostic Screen, select the Relay and Input button to access the Relay & Input Screen.
3. At the Relay & Input Screen, select the Relay button to access the Relay Diagnostics Screen.
4. Check the Relay number that is connected to the VST Control Panel.
5. Push the Action button, then push the Activate Relays buttons. After the Activation button is pushed, the Relay Screen will show again.
6. If the Overfill Alarm is active, the wiring of the Overfill Relay and the Overfill programming is correct. After two hours, the Overfill Alarm will clear.
7. If the Overfill Alarm is NOT active, contact the General Contractor or the electrical contractor to correct the wiring from the VST Control Panel to the TLS-450 Plus Overfill relay, then conduct the test again until the test passes and the Overfill Alarm is active on the VST Control Panel PLC.
8. At the TLS, push the Action button, then push Finish Test.



TLS 450 Plus Overfill Alarm Test, continued...

9. Deselect the Relay #  that is connected to the VST Control Panel.
10. Push the Home button to conclude the Overfill Alarm Test

## 6.9 Changing the Date and Time Procedure

### 6.9.1 Changing the Date and Time Procedure

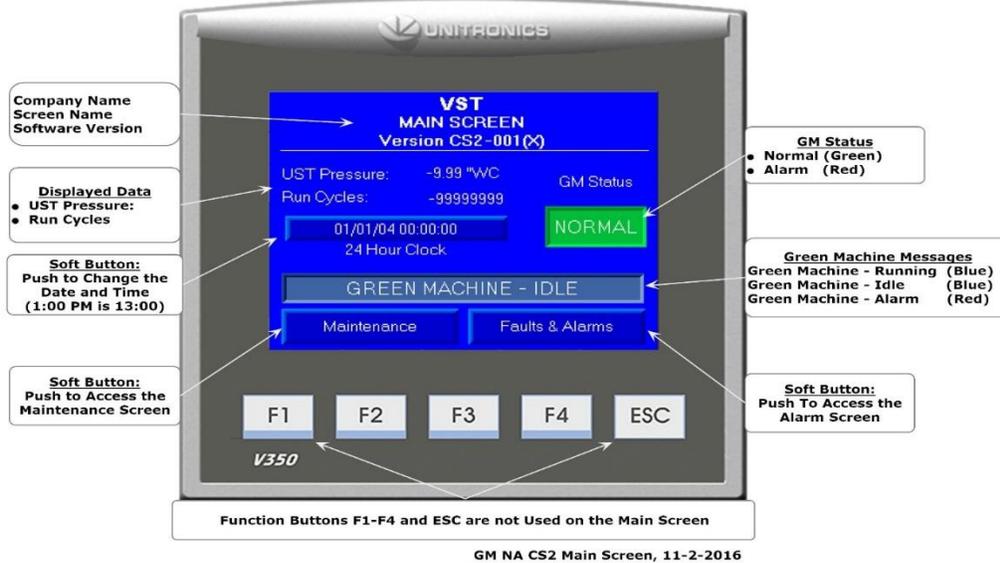


Figure 6-12: Main Screen

1. From the Main Screen, push the Date and Time soft button. This will bring up the Date and Time Interface Screen. **See Figure 6-12.**
2. On the Date and Time Interface Screen, insert the Date: (MM/DD/YY) then the Time: (HH:MM:SS). Use the ARROW keys to move from left or right if a number is not correct. The Time is a 24-hour format so 1:00 PM is set at 13:00 hours. **See Figure 6-13.**
3. After the Date and/or Time has been set, push Return button to accept the change(s) and return to the Main Screen.
4. After returning to the Main Screen, check to see if the Date and Time are correct.

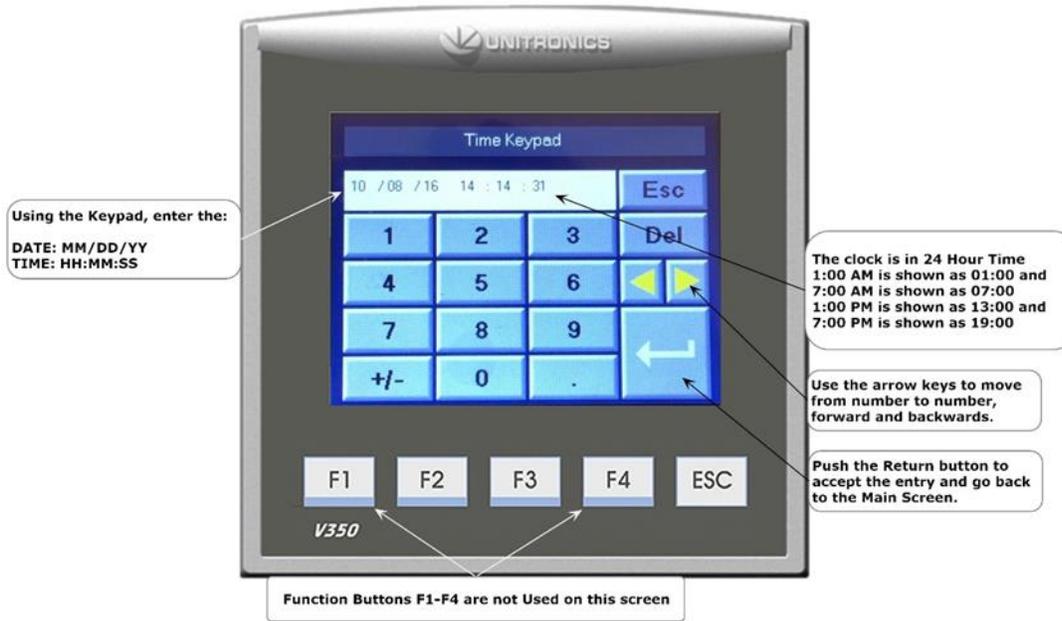


Figure 6-13: Time & Date Screen



## 6.10 Submitting Appendix B to VST for the Verification CODE

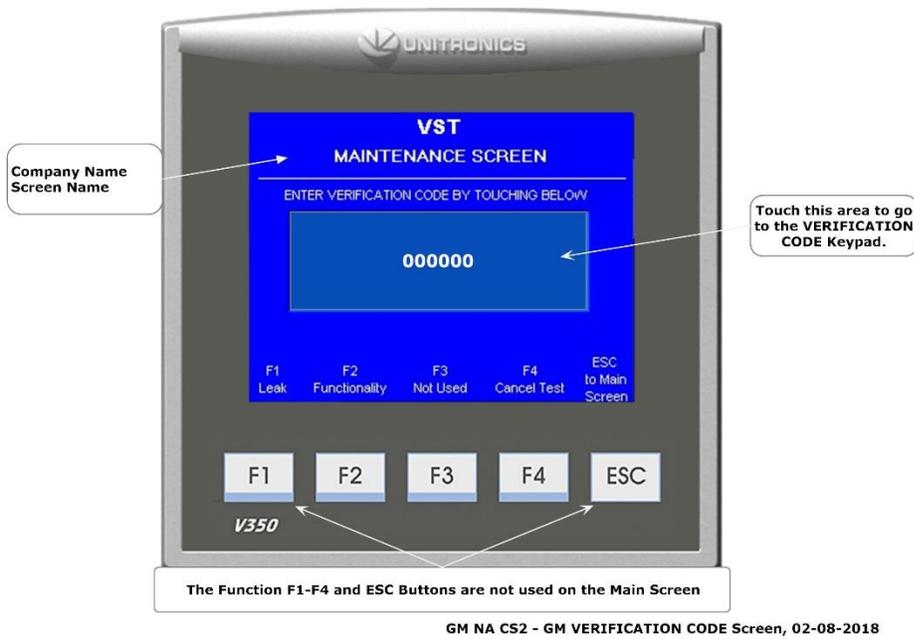
### 6.10.1 Start Up of the GREEN MACHINE

1. Go to [www.vsthose.com](http://www.vsthose.com).
2. Click on “VST Education & Training” at the bottom of the VST Screen
3. Under “US GREEN MACHINE™”  
Click on “Supporting Documents and Instructional Videos.”
4. Click on “Start-Up / Commissioning Contractor.”  
**Note: If you have not been trained to conduct Appendix B, click on “Appendix B – Training Video”, then go to Step 5.**
5. Click on “Appendix B - Start-Up Contractor Check Out Form.”
6. Fill out and submit Appendix B with the required photos.
7. Receive an email from VST with the verification code and a copy of the filled-out Appendix B.

### 6.10.2 Procedures

1. Apply power to the VST Control Panel  
The PLC starts up in the Main Screen where the GREEN MACHINE is shown to be DISABLED.  
**See Figure 6-1.**
2. Push the Maintenance button, then enter 878 on the Password Screen to go to the Maintenance Screen.
3. Using Chapter 6: Testing and Start-Up, complete the following sections:  
Chapter 6 Sections for Reference:  

Section	Title
6.4	Conduct the Bump Test
6.5	Conduct the Functionality Test
6.6	Programming the Fuel Management System Overfill Relay for the GM Overfill Alarm
6.7	Conduct the Overfill Alarm Test
6.8	Change the Date/Time per the time-zone
6.9	How to submit Appendix B to VST to obtain the Verification CODE
4. Complete Appendix B Checklist Form, then push the SUBMIT button.  
(All the fields contained in Appendix B MUST BE CHECKED OR FILLED OUT, INCLUDING PICTURES.)
5. An email with the Verification CODE is sent to the person conducting the Start-Up after Appendix B is SUBMITTED to VST.
6. On the Maintenance Screen, push the Function Buttons F1 & F2 at the same time to bring up the Password Screen to enter the Verification CODE.
7. Push the large button with 000000 showing. **See Figure 6-14.**
8. At the Verification CODE Screen, enter the CODE that was received in the email, then push ENTER.  
**See Figure 6-15.**
9. If the correct CODE was entered, the PLC will show the Main Screen and the GREEN MACHINE will now be operational.
10. If the incorrect CODE is entered, the Verification CODE Screen will show WRONG! Push the large button again and enter the correct Verification CODE.
11. Once the correct Verification CODE is entered, the PLC returns to the Main Screen and the GREEN MACHINE is now fully operational.
12. Function Buttons F1 & F2 will no longer work
13. At the Main Screen, the GREEN MACHINE will turn ON if the UST pressure is at or above 0.20 IWC, or remain OFF if the UST pressure is below 0.20 IWC.
14. The GREEN MACHINE:
  - Is Operational
  - Start-Up is complete and verified
  - The Overfill protection is installed and tested



GM NA CS2 - GM VERIFICATION CODE Screen, 02-08-2018

Figure 6-14: VERIFICATION CODE screen

### VST GREEN MACHINE CODE Verification Screen



GM NA CS2 Verification CODE Input Screen, 02-14-2018

Figure 6-15: Enter the Verification CODE screen



# Chapter 7: Maintenance Procedures

## 7 Maintenance Overview

- VST recommends conducting Maintenance on the GREEN MACHINE annually to make sure all the components are in good working order. If the annual maintenance is not conducted, there is a possibility the GREEN MACHINE may not be operating properly.
- The Vacuum Pump and Control Valves are the only components with moving parts in the GREEN MACHINE; therefore, it requires very little maintenance.
- All replacement parts must be from VST's recommended replacement parts list located in Chapter 9: Replacement Procedures Section.
- If the GREEN MACHINE is not functioning properly consult Chapter 8: Troubleshooting Section to determine which component may need to be repaired or replaced.
- Sections that will be covered in this Chapter:
  - 7.1 Maintenance Procedures
  - 7.2 Recommended Replacement Parts
  - 7.3 Functionality Test Procedure
  - 7.4 Pressure Sensor Verification Test Procedure
  - 7.5 Rubber Flange Sleeve Replacement
  - 7.6 Cleaning the Control Valves
  - 7.7 Check the Air Outlet for Liquid Condensation
  - 7.8 Separator Check Procedure

### 7.1 Maintenance Procedures

1. At the VST Control Panel Main Screen, check to make sure there are no alarms.  
**See Figure 7-1.**  
If there are alarms, repair the item causing the alarm (See Chapter 8: Troubleshooting) before proceeding.
2. VST has recommended spare parts that might be needed when conducting Maintenance. **See Section 7.2.**
3. Conduct a Functionality Test: **See Section 7.3.**  
The Functionality Test will verify the GREEN MACHINE is operating properly.
  - If the Functionality Test Passes, go to Step 3.
  - If the Functionality Test does not Pass (See Chapter 8: Troubleshooting Procedures)
4. The Pressure Sensor Verification Test Procedure: **See Section 7.4.**
  - This procedure will verify that the Pressure Sensor is operating properly and within specifications.



Maintenance Procedures, continued...

5. Rubber Flange Sleeve Replacement Procedure: **See Section 7.5.**  
To keep the GREEN MACHINE operational, replace the rubber flange sleeve yearly.
6. Cleaning the Control Valves: **See Section 7.6.**  
Cleaning the control valves will reduce valve noise. Check the valve components for wear and damage and keep the valves operational for a longer period of time.
7. Check the Air Outlet for Liquid Condensate: **See Section 7.7.**  
Check annually for liquid condensate in the air outlet pipe.
8. Separator Check Procedure: **See Section 7.8.**
  - Check annually for excessive accumulation of debris.

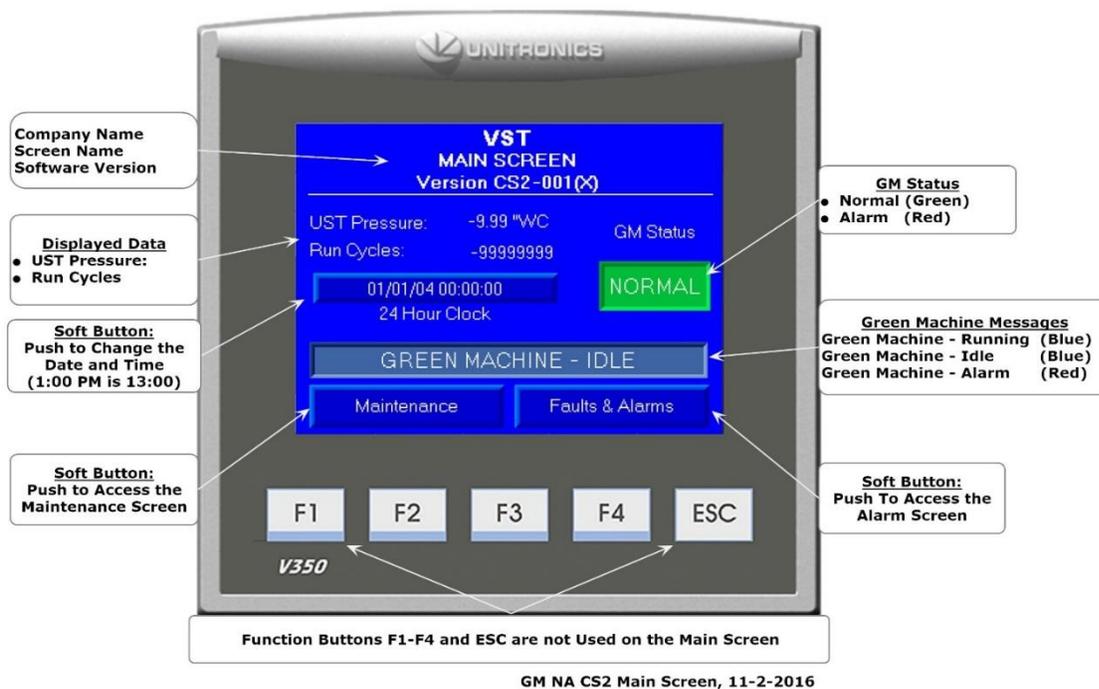


Figure 7-1: VST PLC Main Screen w/no Alarms

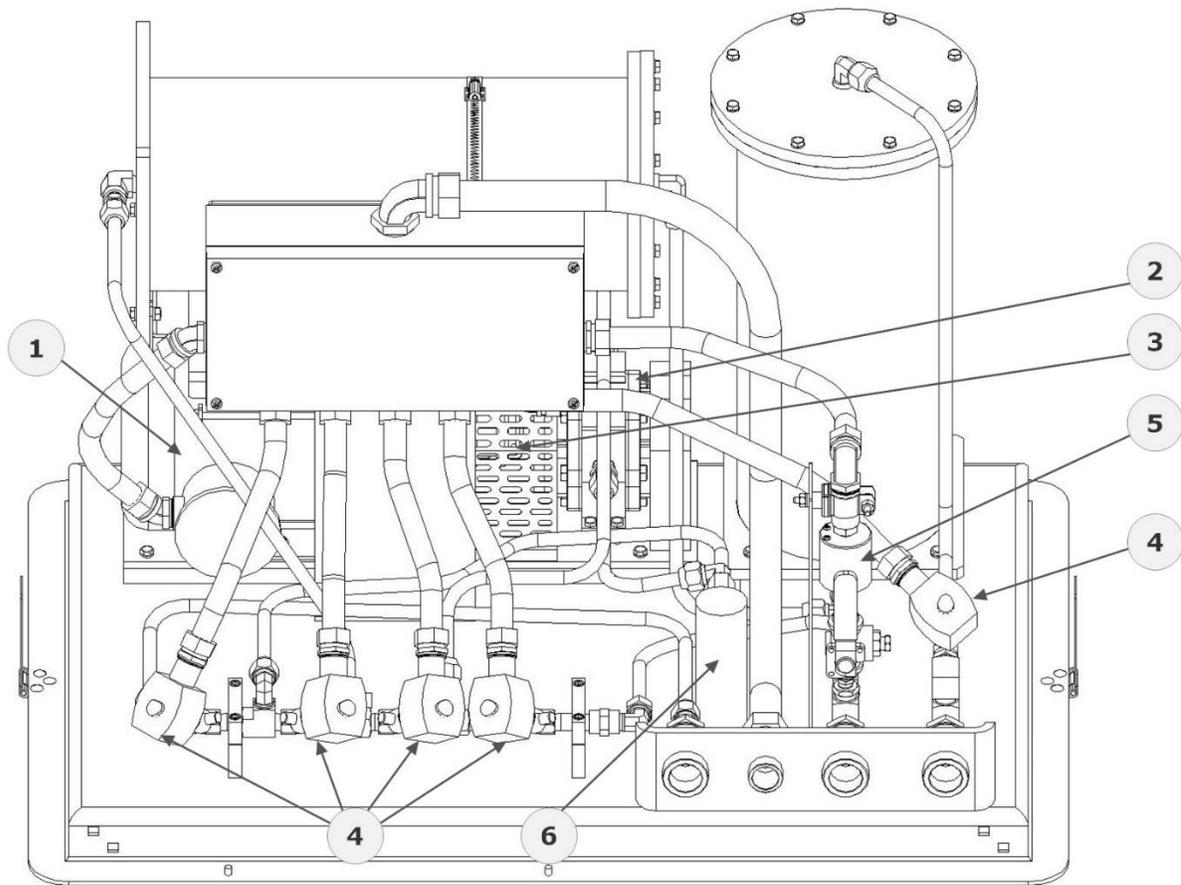


## 7.2 Recommended Replacement Parts

VST recommends the ASC bring the parts shown in the table below for replacement parts. The entire list of GREEN MACHINE replacement parts can be found in Chapter 9: Replacement Procedures.

See Figure 7-2.

Ref. #	Description	Part No.	Quantity	Manuf.
1	VACUUM PUMP MOTOR (ONLY), 115VAC, SINGLE-PHASE	GM-027	1	VST
2	MODEL 2 VACUUM PUMP (ONLY)	GM-022	1	
3	RUBBER FLANGE SLEEVE	GM-004	1	
4	CONTROL VALVES – CORE REBUILD KIT	GM-006	5	
5	PRESSURE SENSOR	GM-043	1	
6	SEPARATOR	GM-049	1	



Green Machine Dual Canister Maintenance Replacement Parts, 09-20-2019

Figure 7-2: Maintenance Replacement Parts



## 7.3 Functionality Test

### 7.3.1 The Purpose of the Functionality Test

The purpose of the Functionality Test is to verify that the Control Panel, Vacuum Pump, and the Control Valves are working properly.

### 7.3.2 Preparation for the Functionality Test

1. At the VST Control Panel, make sure the Maintenance Screen is showing on the PLC.  
**See Figure 7-3.** (The GREEN MACHINE is now in the Manual OFF mode and will not operate.)

If the PLC is not in the Maintenance Screen: At the Main Screen, push the Maintenance Screen button to access the Password Screen, then enter the password to access the Maintenance Screen: Password is 878.

2. At the GREEN MACHINE, make sure the locks from the three ball valves have been removed, all three valves are closed, and the caps from the three tees have been removed.  
**See Figure 7-4.**
3. Unlock the hasp and remove the cover from the GREEN MACHINE.
4. Close the 3-way valve below the Pressure Sensor so the handle is turned HORIZONTAL (OFF or Closed). Leaving the valve ON or Open during this test may damage the Pressure Sensor.

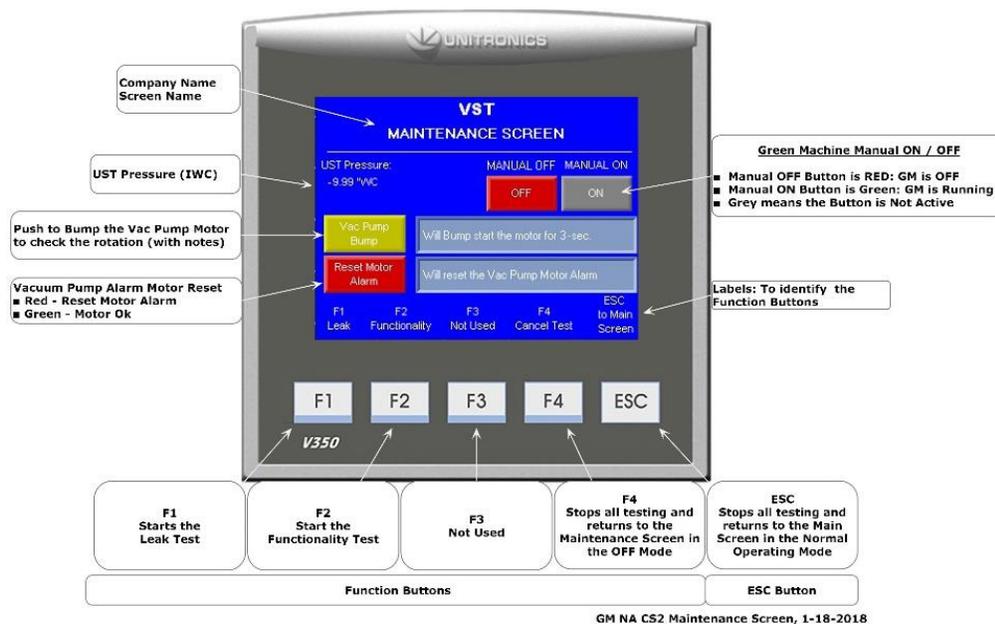


Figure 7-3: Maintenance Screen

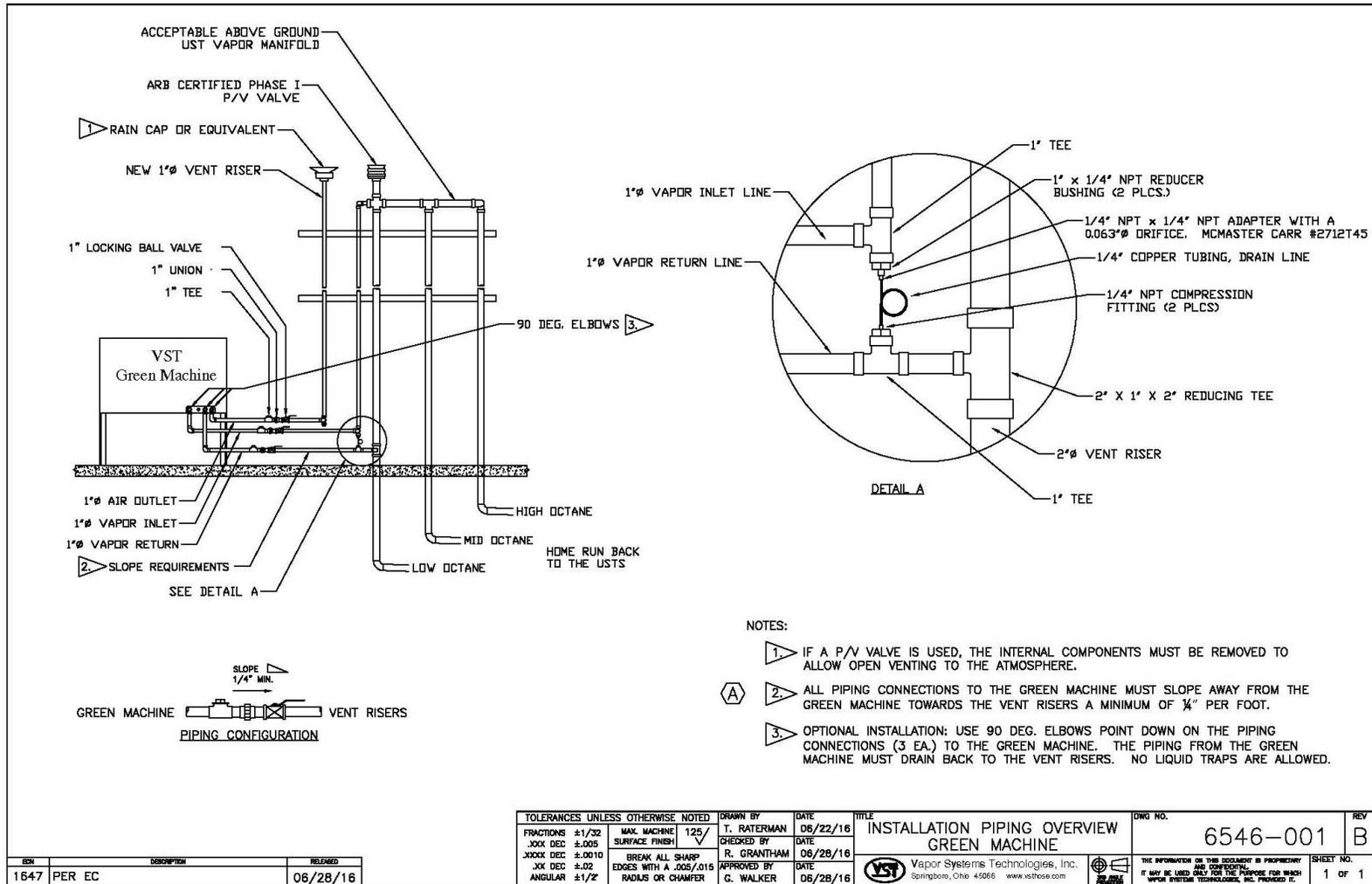


Figure 7-4: GREEN MACHINE Vapor Piping Layout



### 7.3.3 Functionality Test Procedures

1. Push the F2 button to access the Functionality Test Screen. **See Figure 7-5.**
2. To start the Functionality Test, push the Start Button.
3. Push the Confirm Functionality Test Button to confirm you would like to start the Functionality Test.  
**See Figure 7-6.**
4. The GREEN MACHINE will run for 60-seconds then purge for 60-seconds (this is one cycle).
5. The GREEN MACHINE will continue to cycle 5 times or until the F4 button is pushed to end the test.
  - There are 5 cycles to provide enough time to conduct the test.
  - Pushing the F4 button will return the system to the Maintenance Screen and the GREEN MACHINE will be in the OFF mode.
6. When the test has ended, the VST Control Panel PLC will display GREEN MACHINE OFF.
7. During the 60-second Run Cycle: **See Figure 7-7.**
  - Place your hand over the tee opening at the Vapor Inlet and feel for suction.
  - Next, place you hand over the tee opening at the Vapor Return and feel for zero airflow.
  - Next, place your hand over the tee opening at the Air Outlet and feel for air blowing.
8. During the Run Cycle:
  1. Suction at the Vapor inlet: NORMAL
  2. Air blowing out the Air Outlet: NORMAL
  3. No air blowing/suction at the Vapor Return: NORMAL
  4. All other blowing or suction conditions at each location, check the following items:
    - Make sure the Vacuum Pump is not in alarm. If so, see Chapter 8: Troubleshooting, Section 8.6.
    - Check the Control Valves to make sure they are all operational. See Chapter 8: Troubleshooting, Section 8.6.1, Step 5:
    - Make sure there is no debris in the valve seat. Clean the valves as shown in Section 7.5: Cleaning the Control Valves.
    - Make sure the flare nuts are tight. Check each 45-deg. flare nut to make sure they are snug but not over tightened.
9. During the 60-second Purge Cycle: **See Figure 7-7.**
  - After the Purge Cycle has begun, place your hand over the tee opening at the Vapor Return and feel for air blowing. The blowing air will reduce to zero flow soon after the Purge Cycle begins.
  - Next, place your hand over the tee opening at the Vapor Inlet and feel for zero airflow.
  - Next, place your hand over the tee opening at the Air Outlet and feel for zero airflow.



Functionality Test, continued...

10. During the Purge Cycle:

1. No air blowing/suction at the Vapor Inlet: NORMAL
2. No air blowing/suction at the Air Outlet: NORMAL
3. Momentary blowing at the Vapor Return: NORMAL
4. All other blowing or suction conditions at each location:
  - Make sure the Vacuum Pump is not in alarm. If so, see Chapter 8: Troubleshooting, Section 8.6.
  - Check the Control Valves to make sure they are all operational. See Chapter 8: Troubleshooting, Section 8.6.1, Step 5:
  - Make sure there is no debris in the valve seat. Clean the valves as shown in Section 7.5: Cleaning the Control Valves.
  - Make sure the flare nuts are tight. Check each 45-deg. flare nut to make sure they are snug but not over tightened.

11. After the Functionality Test has ended:

- The PLC will automatically go back to the Maintenance Screen and will remain in the OFF mode.
- Lock open the three ball valves between the GREEN MACHINE and the Vent Risers, and replace the caps on the three tees.
- **CAUTION: Make sure the 3-way valve below the Pressure Sensor is turned VERTICAL (ON or Open). Leaving the valve turned OFF at the Pressure Sensor will not allow the GREEN MACHINE to operate in the Normal Operating Mode.**
- At the PLC, push the ESC button to return to the Main Screen.

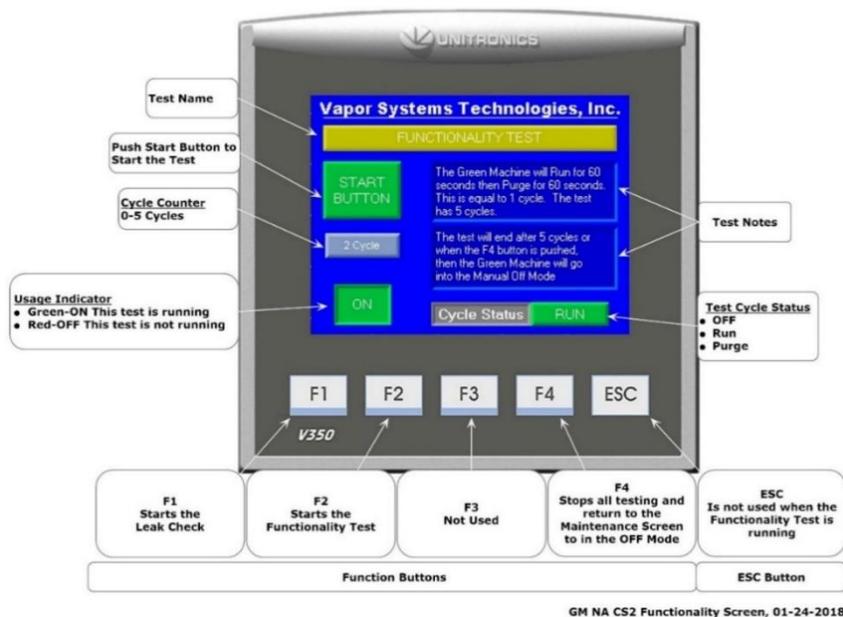


Figure 7-5: Functionality Test Screen

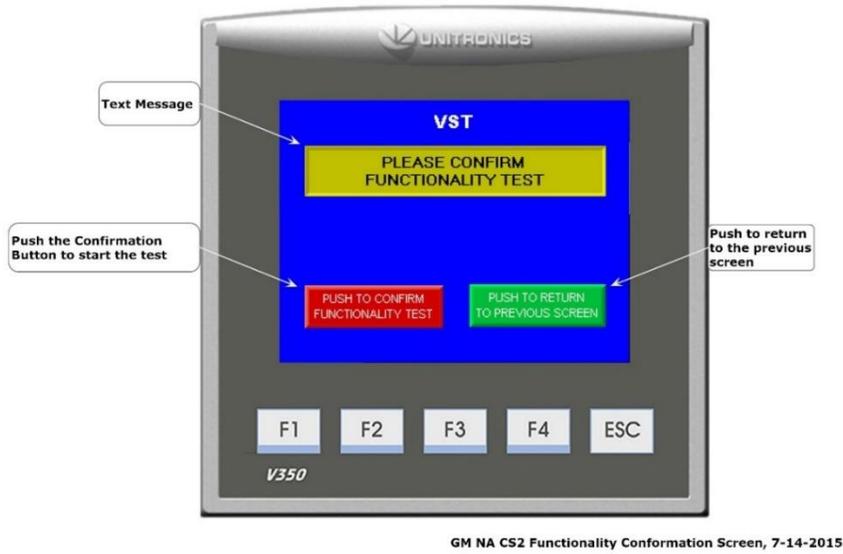


Figure 7-6: Functionality Test Confirmation Button

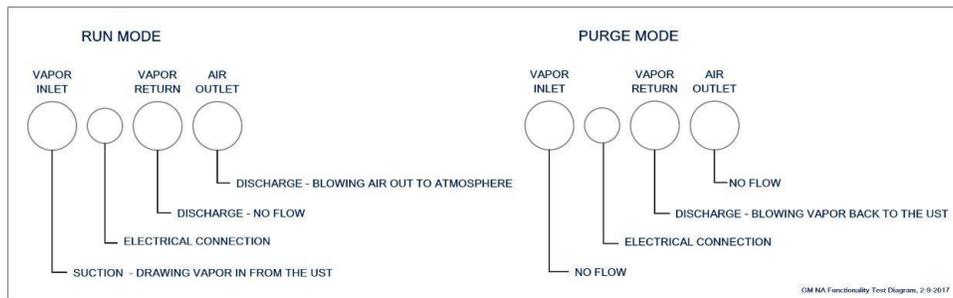


Figure 7-7: GREEN MACHINE Operation Diagram



## 7.4 Pressure Sensor Verification Test

This procedure was written to verify the Pressure Sensor is operating properly and within specifications: The Pressure Sensor reading on the VST Control Panel PLC Main Screen is checked against atmospheric pressure at the Pressure Sensor.

### 7.4.1 Safety:



Use lockout-tagout procedures prior to starting work.

### 7.4.2 Procedure:

1. Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel.
  - This will allow 24 VDC power to the PLC and the Pressure Sensor but will disconnect 115 VAC power to the GREEN MACHINE. Power to the PLC and Pressure Sensor will remain ON.
2. Follow lockout & tagout procedures prior to starting work.
3. Unlock the hasps and remove the cover from the GREEN MACHINE.
4. Turn the handle on the 3-way ball valve located below the Pressure Sensor to horizontal (Closed) so the Pressure Sensor will read atmospheric pressure. **See Figure 7-8**
  - With the 3-way valve handle turned horizontal (Closed), the valve will not be open to gasoline vapor.
5. Remove the ¼" NPT Hex Plug from the side of the 3-way ball valve. **See Figure 7-9.**
6. Wait at least 2-minutes for the pressure to equalize before reading the pressure on the PLC Main Screen.
7. At the VST Control Panel PLC Main Screen, make sure the Pressure reading is 0.0 +/- 0.10 IWC. **See Figure 7-10.**

The Pressure Sensor Specification at atmospheric Pressure is 0.0 +/- 0.10 IWC.

  - If the pressure reading is within specifications, the Pressure Sensor is reading correctly.
  - If the pressure reading is outside the specification, replace the Pressure Sensor. In the IOMT Manual, See Chapter 9, Section 9.4 for replacement procedures.
8. After testing is complete: Reinstall the ¼" NPT Hex Plug on the 3-way valve. Use gasoline resistant PTFE tape on the ¼" NPT Hex Plug pipe threads prior to installation.
9. Turn the handle on the 3-way ball valve located below the Pressure Sensor to vertical (Open) so the Pressure Sensor will read UST pressure. **See Figure 7-8.**

**(CAUTION: IF THE 3-WAY VALVE HANDLE IS NOT VERTICAL AS SHOWN IN FIGURE 1, THE GREEN MACHINE WILL NOT OPERATE PROPERLY AND MAY CAUSE DAMAGE TO THE VACUUM PUMP.)**
10. Put the cover on the GREEN MACHINE and lock the hasps.
11. Turn ON power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel. The GREEN MACHINE is now operational and will operate if the UST pressure is greater than or equal to 0.20 IWC.
12. Check the VST Control Panel to make sure the Main Screen is showing and there are no alarms.

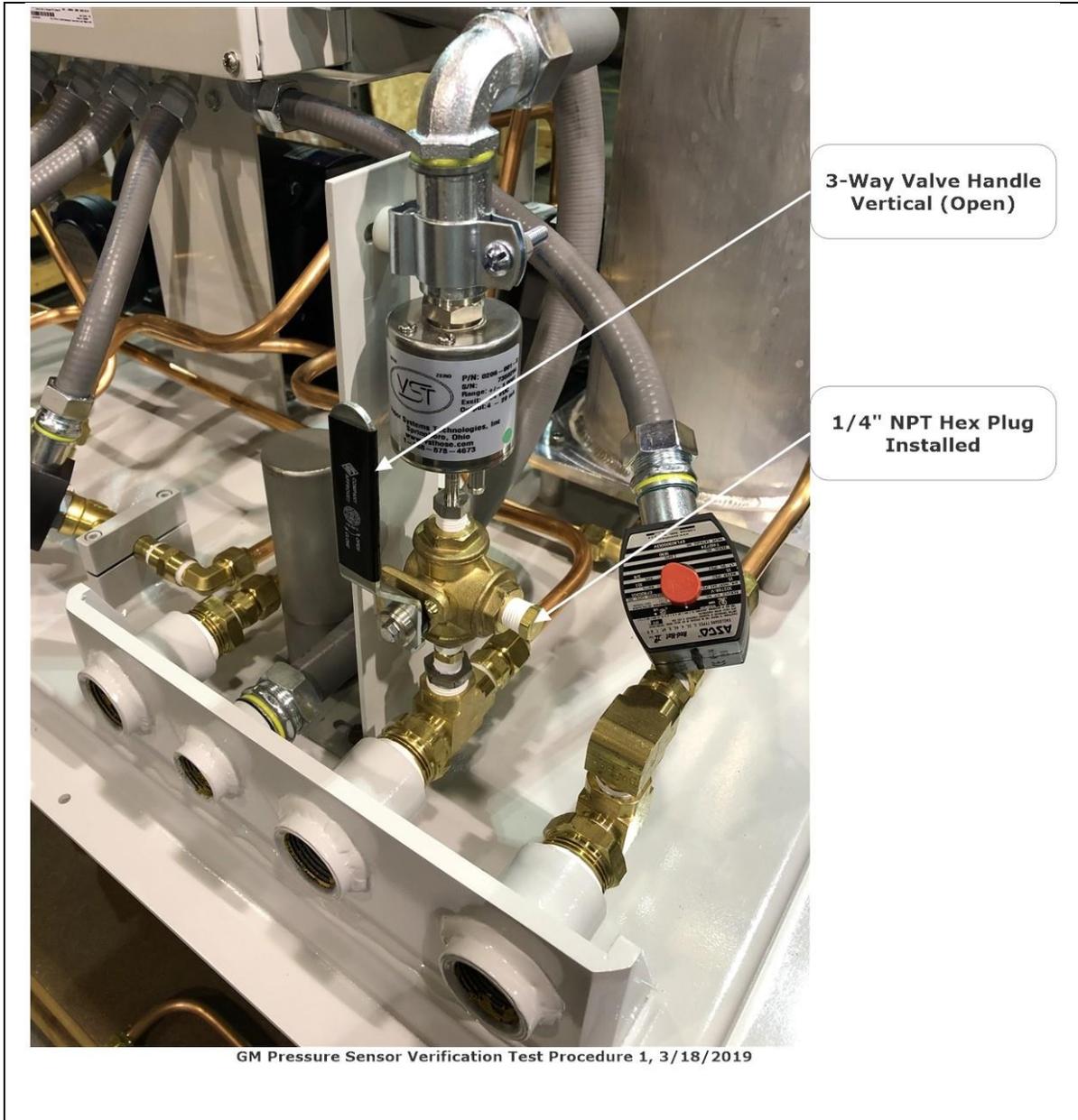


Figure 7-8: Pressure Sensor & 3-Way Valve, NORMAL Operation

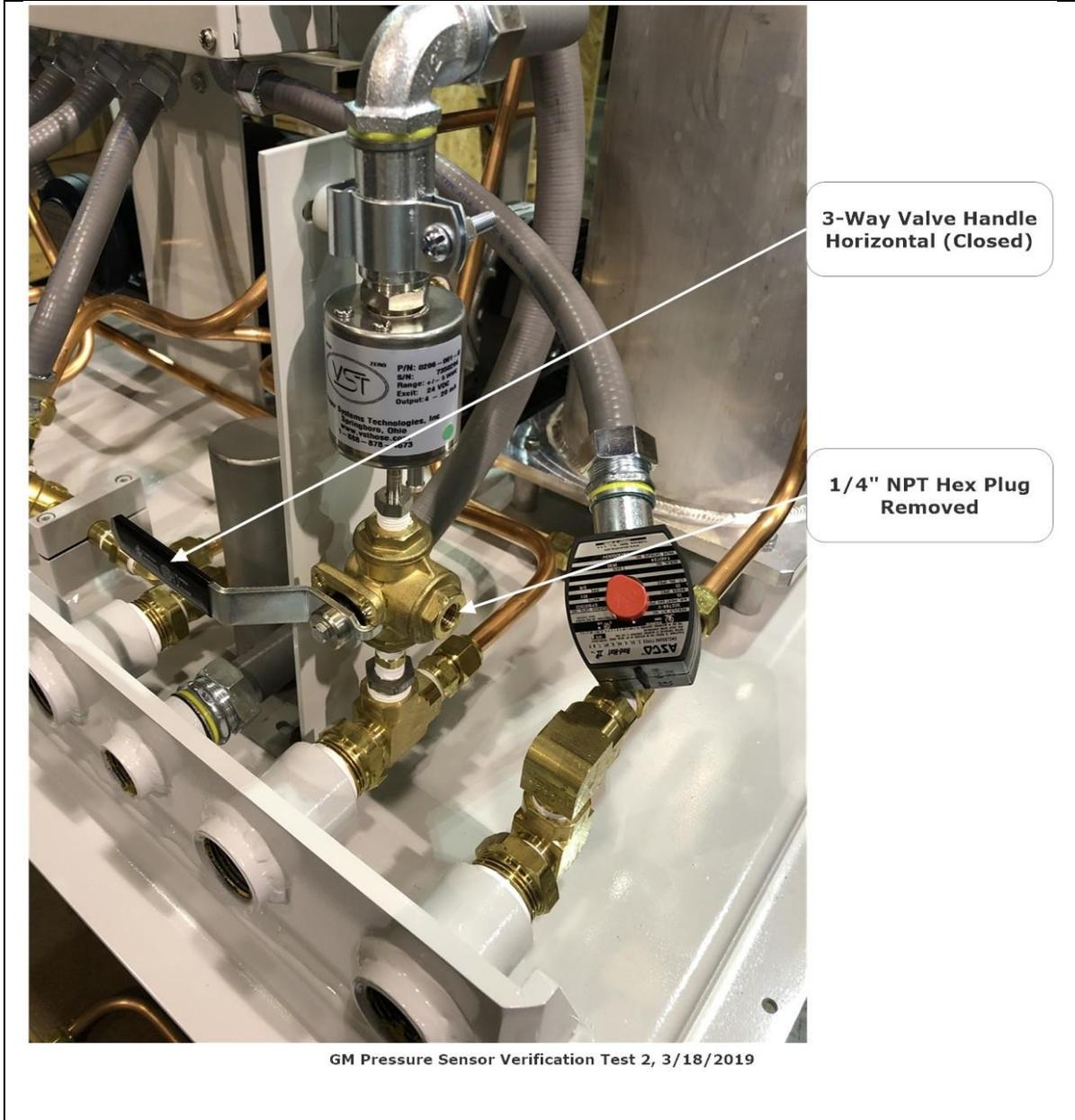


Figure 7-9: Pressure Sensor & 3-Way Valve, TEST Position

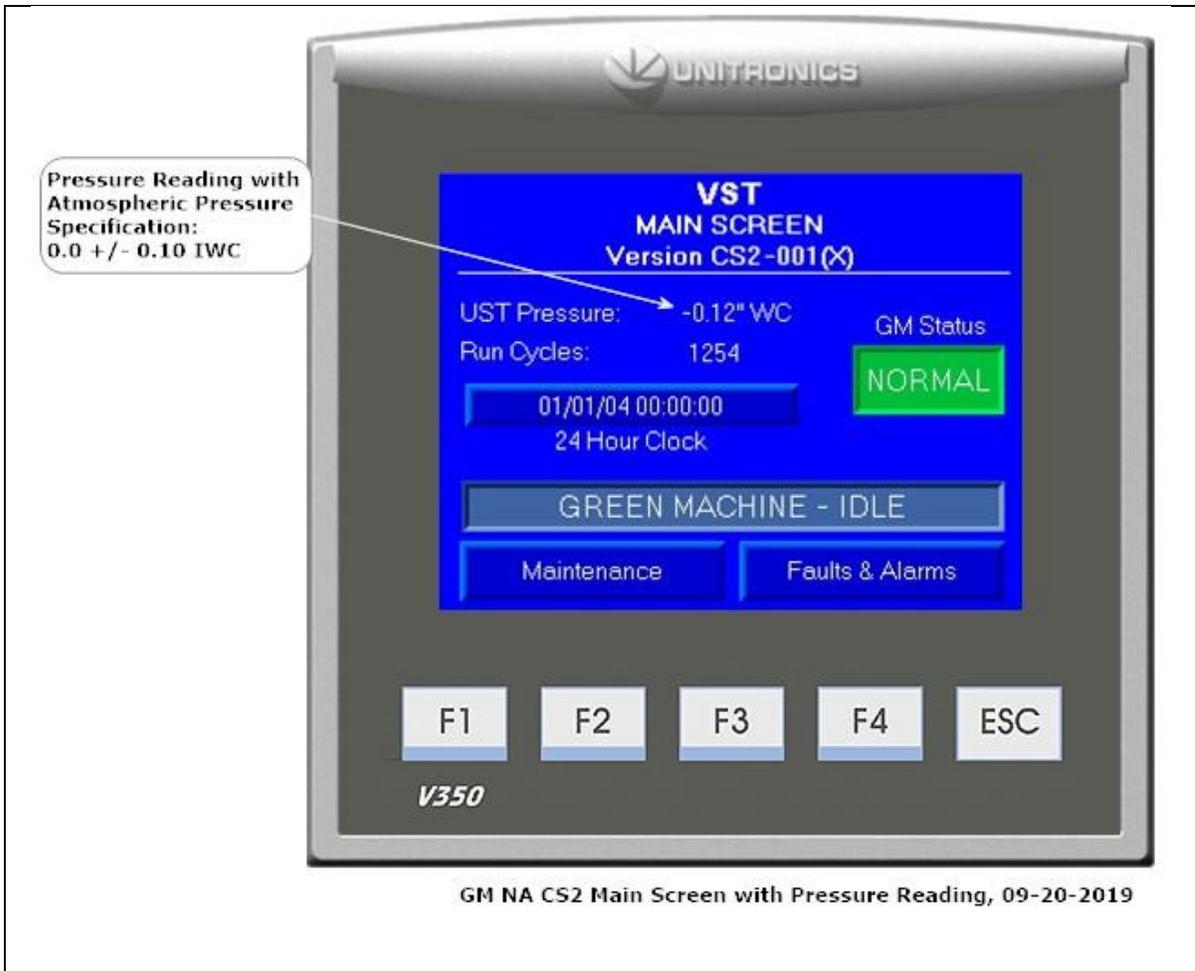


Figure 7-10: Main Screen w/Pressure Reading



## 7.5 Rubber Flange Sleeve Replacement

### Safety



Use lockout / tagout procedures prior to starting work.

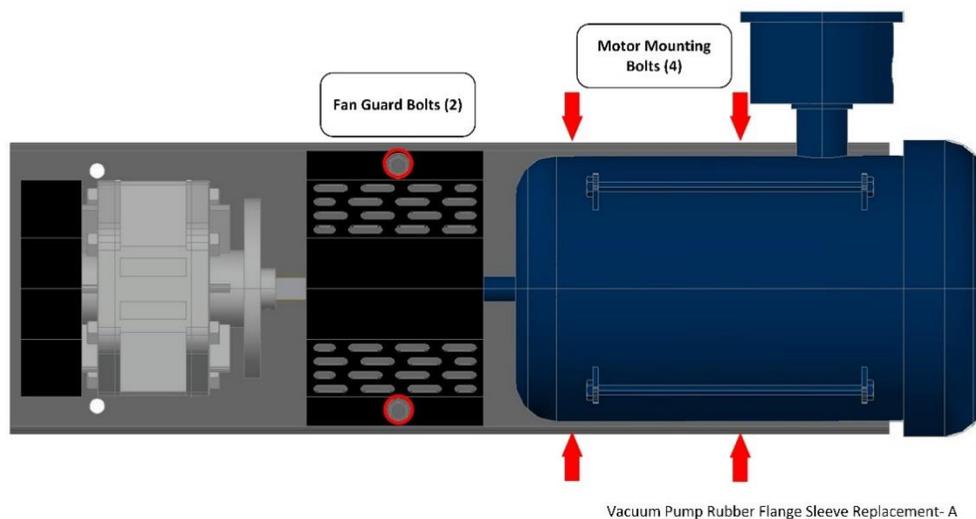
VST recommends replacing the Rubber Flange Sleeve every time Maintenance is performed on the GREEN MACHINE even if the Rubber Flange Sleeve does not look damaged or worn.

#### 7.5.1 Removing the Rubber Flange Sleeve

**See Figure 7-11.**

1. Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel. (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE).
2. Follow lockout & tagout procedures prior to starting work.
3. Unlock the hasps and remove the cover from the GREEN MACHINE.  
NOTE: The Vacuum Pump and Vacuum Pump tubing will not be affected by moving the Vacuum Pump motor.
4. Remove the fan guard over the drive coupling flanges.
5. Remove the two bolts holding the Internal Junction Box stand to the GREEN MACHINE base. Keep the bolts for reuse.
6. Remove the 4 motor mounting bolts from the motor base plate. Keep the shims from under the motor base and 4-bolts for reuse.
7. Without removing the electrical service from the Vacuum Pump motor, slide the motor away from the Vacuum Pump so the rubber flange sleeve can be removed.

**See Figure 7-12.**



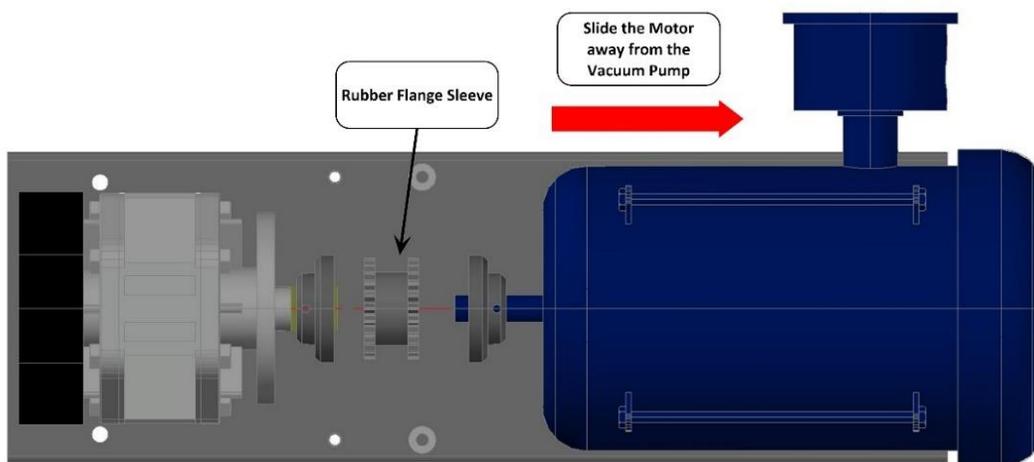
**Figure 7-11: Vac Pump Rubber Flange Sleeve Replacement**



## 7.5.2 Replacing the Rubber Flange Sleeve

See Figure 7-12.

1. Insert a new rubber flange sleeve and slide the motor back to its original position.
  - Make sure the motor-side drive coupling is snug (not tight) against the rubber flange sleeve.
2. Replace any shims that moved while moving the motor.
3. Re-install and tighten the 4 motor mounting bolts to the base plate. Make sure the Motor Shaft and Vacuum Pump shafts are in alignment.
4. Re-install the 2-bolts holding the Internal Junction Box stand to the GREEN MACHINE base.
5. Re-install the fan guard over the coupling flanges.
6. Put the cover on the GREEN MACHINE and lock the hasps.
7. Remove the lock(s) and tags from the lockout & tagout.
8. After the work is completed, turn ON power to the VST Control Panel. The GREEN MACHINE is now operational.



Vacuum Pump Rubber Flange Sleeve Replacement- A1

Figure 7-12: Replacing the Rubber Flange Sleeve

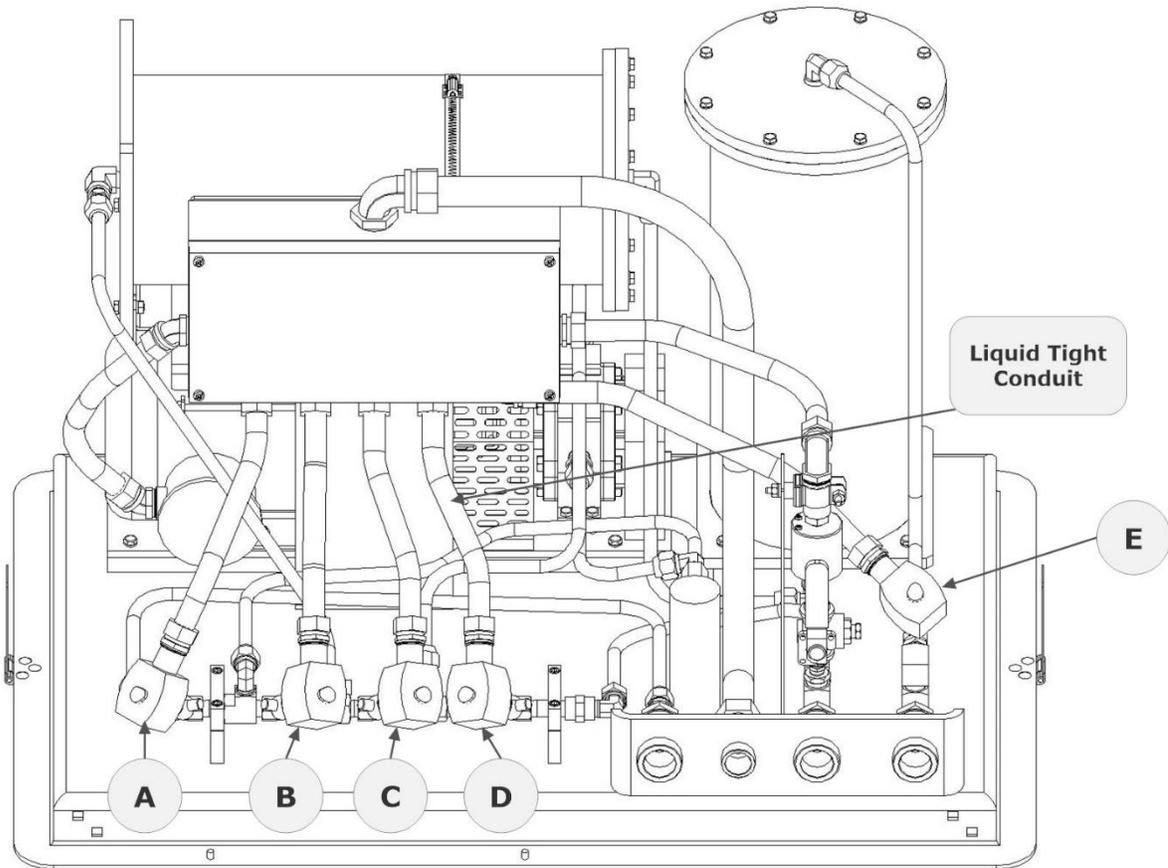


## 7.6 Cleaning the Control Valves

### Safety



Use lockout / tagout procedures prior to starting work.



GM Dual Canister Control Valve Replacement Diagram, 09-20-2019

Figure 7-13: GREEN MACHINE Control Valves Identification Tags



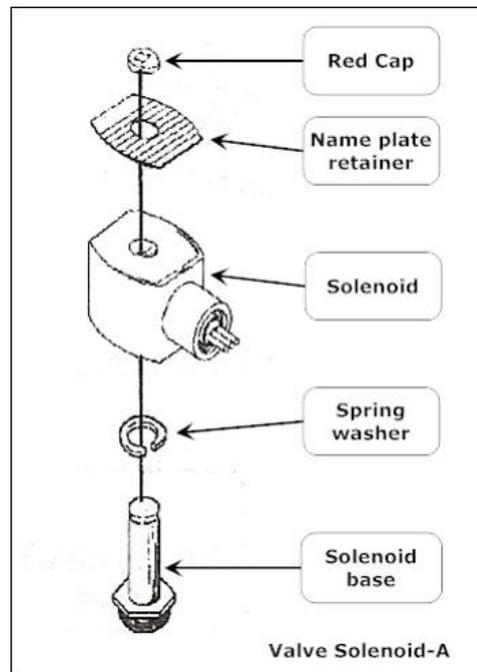
### 7.6.1 Removing the Valve Solenoid and Core Assembly

1. Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel. (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE).
2. Follow lockout & tagout procedures prior to starting work.
3. Unlock the hasps and remove the cover from the GREEN MACHINE.
4. Unlock and close the three ball valves between the GREEN MACHINE and the vent risers.

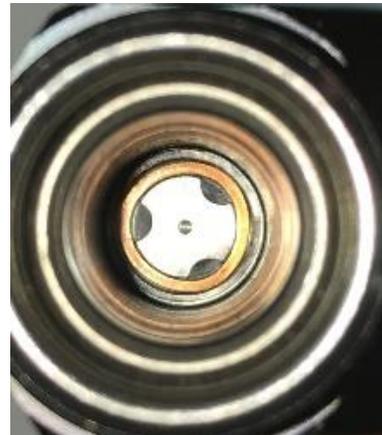
**NOTE:** The Liquid Tight conduit or fitting do not have to be removed from the solenoid. **See Figure 7-13.**

**See Figure 7-14.**

5. Remove the red cap from the solenoid that is not working.
6. Remove the nameplate by pushing the solenoid down towards the valve body, then lift and slide the nameplate off.
7. Slide the solenoid off the solenoid base. **DO NOT** lose the spring washer located below the solenoid on the solenoid base.
8. Using a  $\frac{3}{4}$ " wrench, remove the solenoid base from the valve body, the core assembly with core spring, and the body gasket.
9. Inspect and clean the following parts with a rag and carburetor cleaner or an equivalent cleaning solution: **Be sure to use eyes and hands protection.**
10. Check to make sure the copper ring in the bottom of the solenoid base is not missing or broken into pieces. **See Figure 7-15.**
11. Clean the core assembly, including the metal plunger, the spring, and the rubber seal.
12. Check the rubber seal on the bottom of the core assembly for distortion. Distortion would indicate an indentation into the rubber from the valve seat.
13. Check to see if the spring is cracked or broken.
14. Inspect the body gasket in the valve base for damage and wear.
15. If there is any damage, broken parts, or excessive wear on any part of a control valves assembly, VST recommends that all five control valves be replaced.



**Figure 7-14: Valve Solenoid Assembly**



**Figure 7-15: Solenoid Base Interior**



## 7.6.2 Replacing the Valve Solenoid and Core Assembly

See Figure 7-16.

1. Install the clean Core Assembly which includes:
  - Solenoid base
  - Core assembly with core spring
  - Body gasket
2. Screw the solenoid base and tighten with a  $\frac{3}{4}$ " wrench until tight. Make sure to install the body gasket with the solenoid base.
3. Place the spring washer on the solenoid base, then slide the solenoid on to the solenoid base.
4. Slide and lock the nameplate on the solenoid.
5. Snap the red cap on the solenoid base.
6. Open the three ball valves between the GREEN MACHINE and the vent risers and lock in the OPEN position.
7. **CAUTION: THREE BALL VALVES BETWEEN THE GREEN MACHINE AND THE VENT RISERS MUST BE OPEN BEFORE APPLYING POWER TO THE VST CONTROL PANEL TO AVOID DAMAGE TO THE GREEN MACHINE INTERNAL EQUIPMENT.**
8. Put the cover on the GREEN MACHINE and lock the hasps.
9. Remove the lock(s) and tags from the lockout & tagout.
10. After the work is completed, turn ON power to the VST Control Panel. The GREEN MACHINE is now operational.

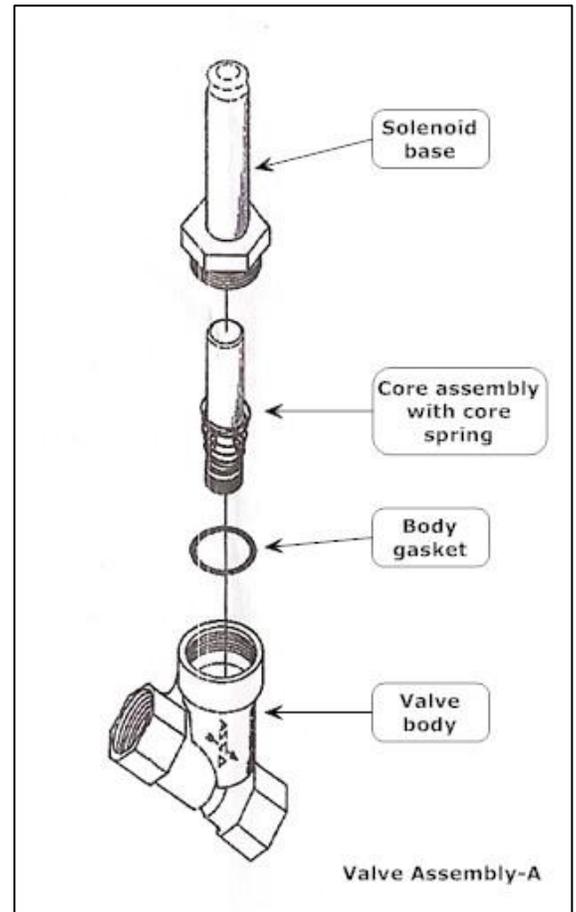


Figure 7-16: Valve Core Assembly



## 7.7 Check the Air Outlet for Liquid Condensation

### 7.7.1 Safety



Use lockout / tagout procedures prior to starting work.

### 7.7.2 Removing the Drain Plug

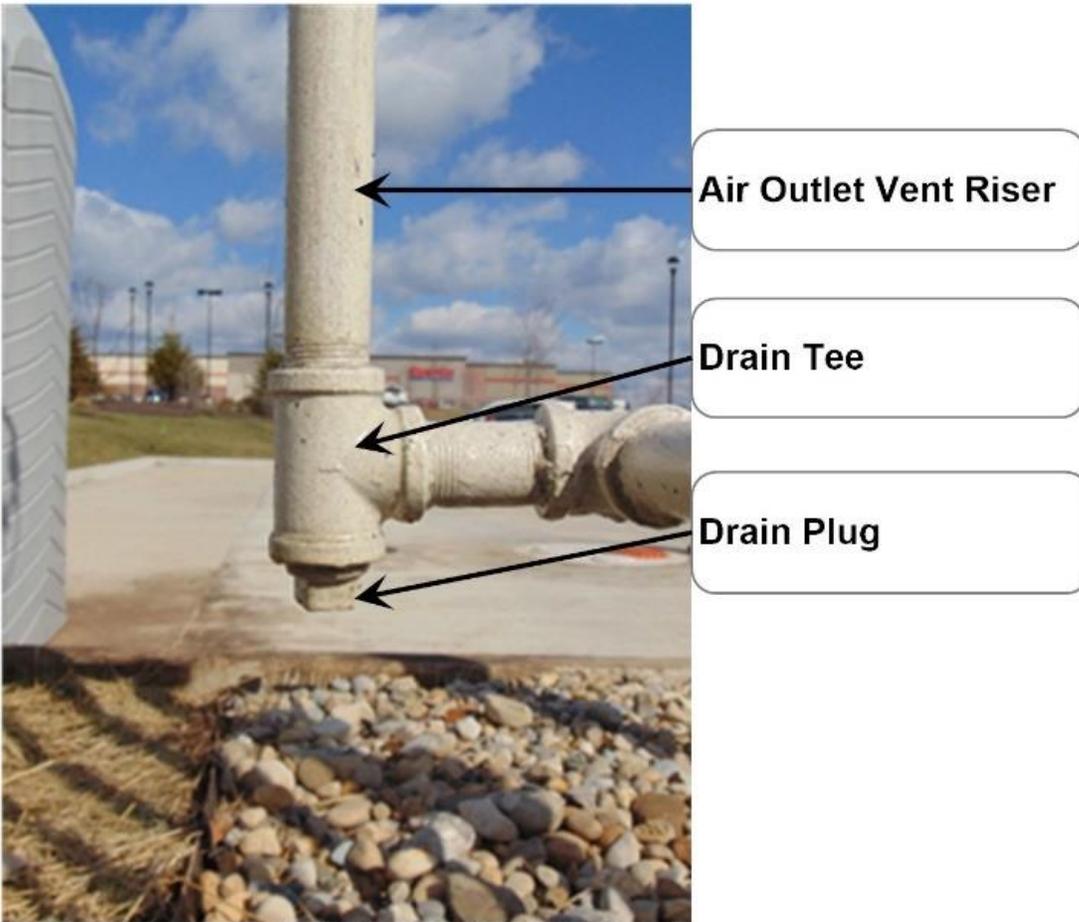
**See Figure 7-17.**

1. Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel. (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE).
2. Follow lockout & tagout procedures prior to starting work.
3. Place a container below the drain tee at the bottom of the Air Outlet vent riser.
4. Slowly remove the drain plug from the bottom of the Air Outlet vent riser to see if any liquid drains from the line.
5. Keep the drain plug for re-use.

### 7.7.3 Replacing the Drain Plug

**See Figure 7-17 .**

1. After all the liquid has drained (if any), put non-hardening pipe-joint compound on the plug threads.
2. Re-install the plug into the drain tee, and tighten.
3. Remove the lock(s) and tags from the lockout & tagout.
4. After the work is completed, turn ON power to the VST Control Panel. The GREEN MACHINE is now operational.



**Air Outlet Drain Tee and Plug, 3-16-2017**

**Figure 7-17: Air Outlet, Drain Tee, and Plug**



## 7.8 Separator Check Procedure

### 7.8.1 Safety

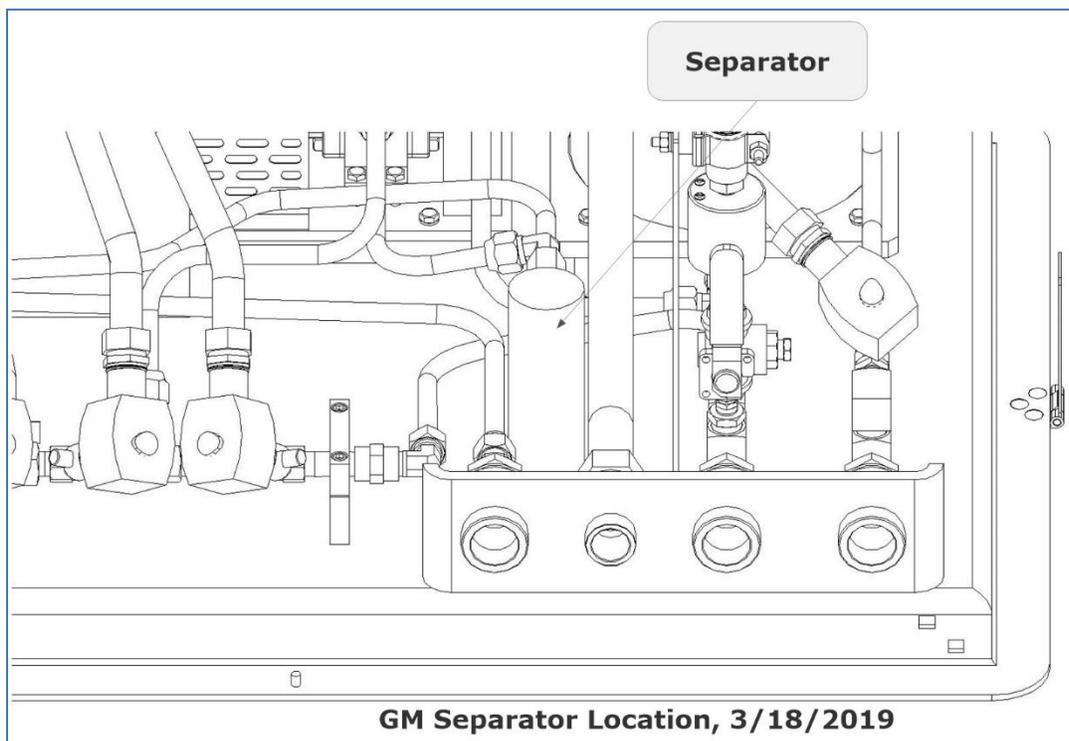


Use lockout / tagout procedures prior to starting work.

### 7.8.2 7.7.1 Removing and Inspecting the Separator

**See Figure 7-18.**

1. Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel. (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE).
2. Follow lockout-tagout procedures prior to starting work.
3. Unlock the hasps and remove the cover from the GREEN MACHINE.
4. Remove the two 45° flare tubing connections from the separator, being careful not to damage the copper tubing.
5. Remove the separator and while holding it vertically, gently shake it from side to side.
6. If there is clearly excessive debris inside the separator, the separator must be replaced.



**Figure 7-18: Separator Location**



### 7.8.3 7.7.2 Reinstalling the Existing Separator

**See Figure 7-18.**

1. If the existing separator is still functioning properly, place the separator back into position in the GREEN MACHINE.
2. Re-install two 45° flare tubing connections.  
**CAUTION:** Do not use any thread sealing compound when assembling the 45° flare nuts.  
**CAUTION:** When tightening the 45° flare nuts: Clamp the tube flare between nut and nose body of the tube by screwing the nut on finger tight. Tighten with a wrench an additional ¼ turn for a metal-to-metal seal.
3. Put the cover on the GREEN MACHINE and lock the hasps.
4. Remove the lock(s) and tags from the lockout-tagout.
5. After the work is completed, turn ON power to the VST Control Panel. The GREEN MACHINE is now operational.

### 7.8.4 Installing a New Separator

**See Figure 7-19.**

1. If the existing separator needs to be replaced, remove the 90° and straight pipe fittings from the existing separator for reuse. The existing separator can be discarded.
2. Wrap the pipe fittings with gasoline resistant PTFE tape, and install the pipe fittings into the new separator.
3. Place the new separator into position in the GREEN MACHINE.
4. Re-install two 45° flare tubing connections.  
**CAUTION:** Do not use any thread sealing compound when assembling the 45° flare nuts.  
**CAUTION:** When tightening the 45° flare nuts: Clamp the tube flare between nut and nose body of the tube by screwing the nut on finger tight. Tighten with a wrench an additional ¼ turn for a metal-to-metal seal.
5. Put the cover on the GREEN MACHINE and lock the hasps.
6. Remove the lock(s) and tags from the lockout-tagout.
7. After the work is completed, turn ON power to the VST Control Panel. The GREEN MACHINE is now operational.

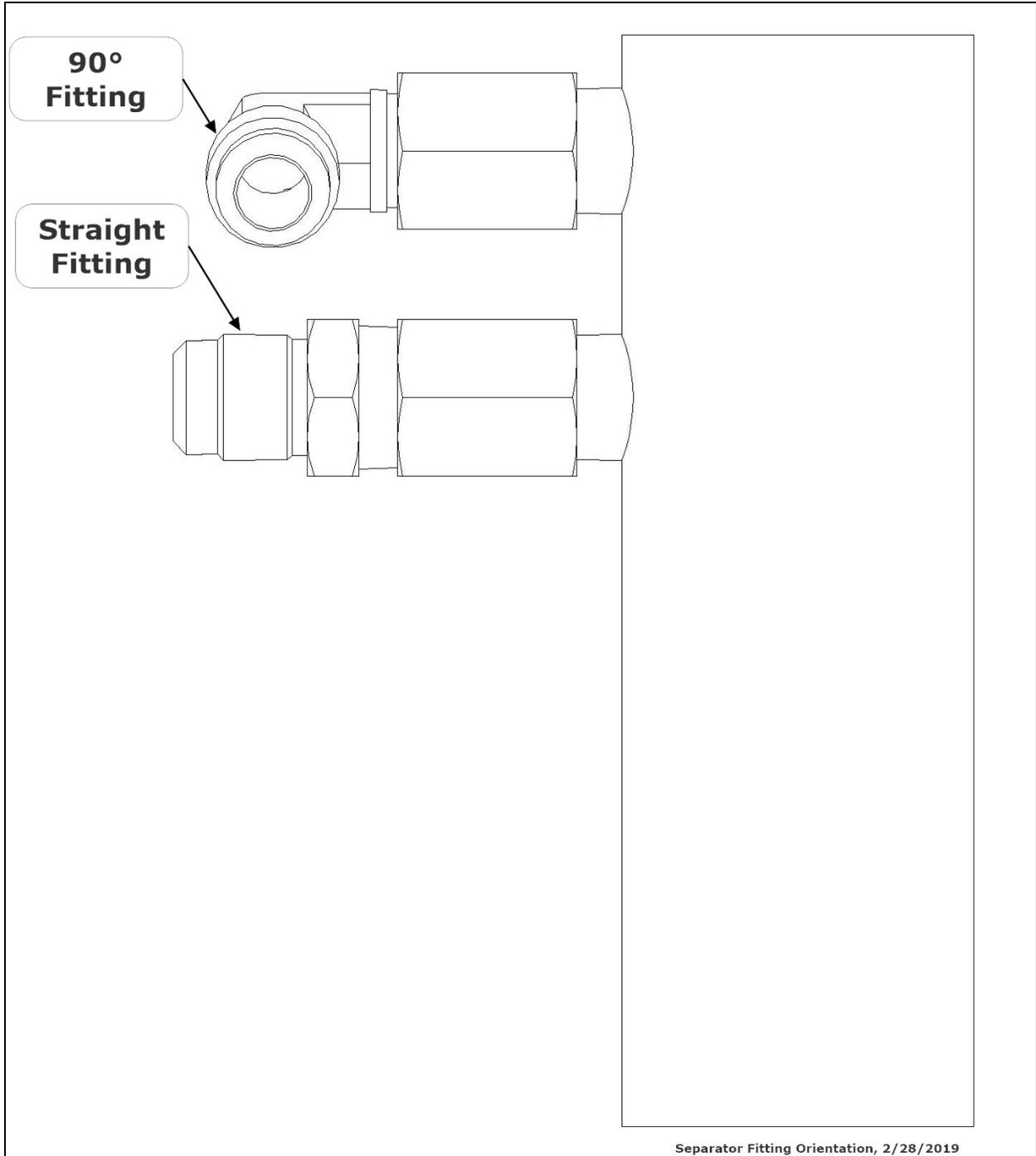


Figure 7-19: Separator Fitting Orientation



# Chapter 8: Troubleshooting

## 8 Troubleshooting Procedures

### 8.1 Troubleshooting Procedures Overview

- The purpose of the Troubleshooting chapter is to explain what troubleshooting actions to take when the GREEN MACHINE or the VST Control Panel are not functioning properly.
- In detail, this guide will cover:
  - 8.2 Alarm Overview
  - 8.3 Troubleshooting Procedures
- Replacement parts procedures are found in Chapter 9.

#### 8.1.1 Troubleshooting the GREEN MACHINE and the VST Control Panel

- Included in this manual are the troubleshooting procedures for the following items:
  - 8.4 Power to the VST Control Panel or PLC Controller is OFF
  - 8.5 Pressure Sensor Alarm
  - 8.6 Vacuum Pump Alarm
  - 8.7 Maintenance Switch Alarm
  - 8.8 Overfill Alarm
  - 8.9 SD Card Alarm



## 8.2 Alarm Overview

- The VST Control Panel is continuously monitoring the VST GREEN MACHINE for alarm conditions.
  - During normal operation when the GREEN MACHINE is functioning properly and no alarm conditions exist, the “NORMAL” message in a Green Box will appear in the Main Screen GM Status window.  
**See Figure 8-1.**
  - When an Alarm is posted, the “NORMAL” message changes to “ALARM” and the Message box changes from Green to Red. **See Figure 8-2.**
- If an Alarm occurs, the Alarm Screen will show what is in the alarm condition.  
**See Figure 8-3.**
  - If more than one alarm condition exists, the display will show all the alarm conditions and the appropriate messages.
  - The system automatically posts an alarm to the SD Card (if installed) showing the alarm type and the date and time the alarm condition occurred.
- No power to the Control Panel does not generate an alarm.

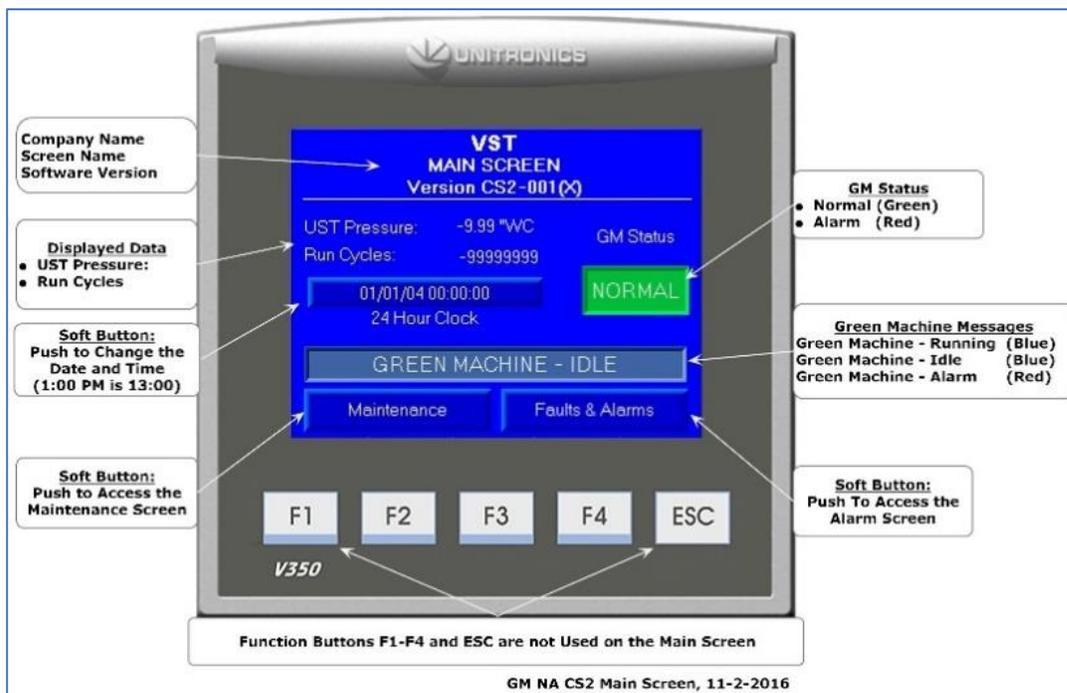


Figure 8-1: VST GREEN MACHINE Control Panel Main Screen

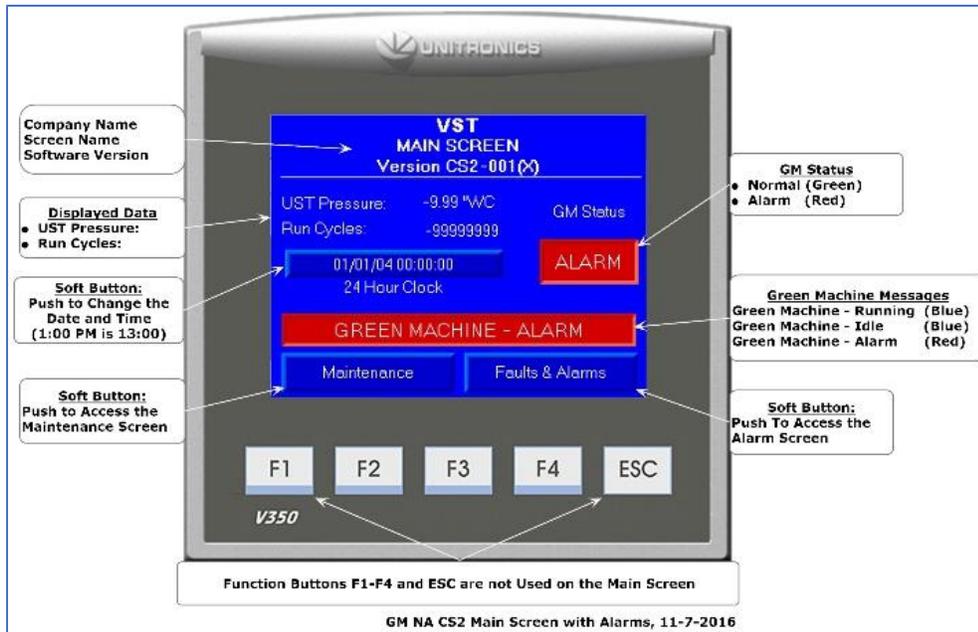


Figure 8-2: VST GREEN MACHINE Control Panel Main Screen with an Alarm Active

### 8.2.1 Alarm List

1. Pressure Sensor Alarm
2. Vacuum Pump Alarm
3. Maintenance Switch Alarm
4. Overfill Alarm
5. SD Card Alarm

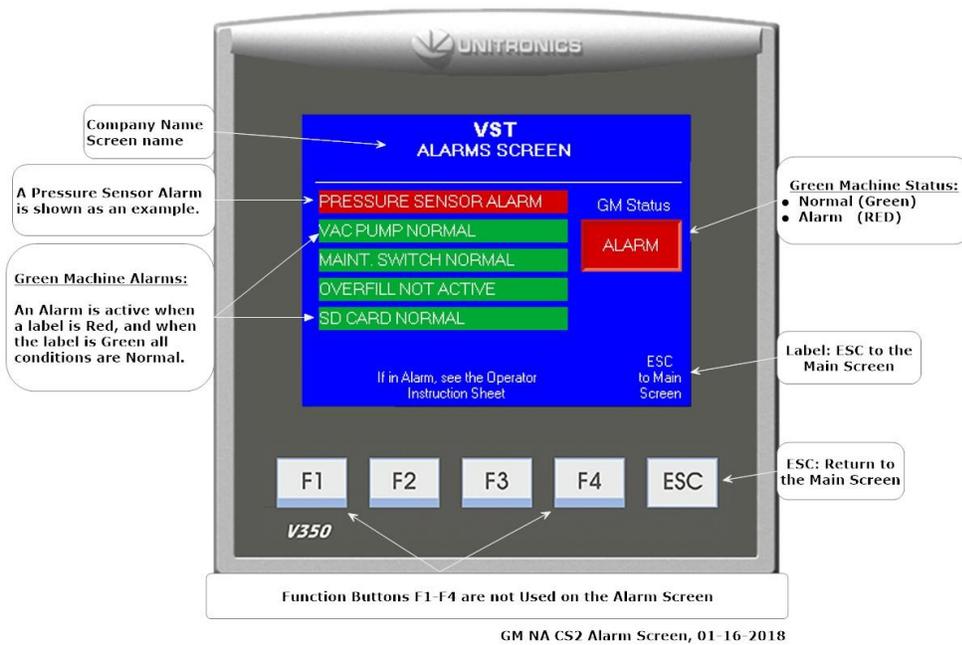


Figure 8-3: VST Control Panel Alarms and Faults Screen Example

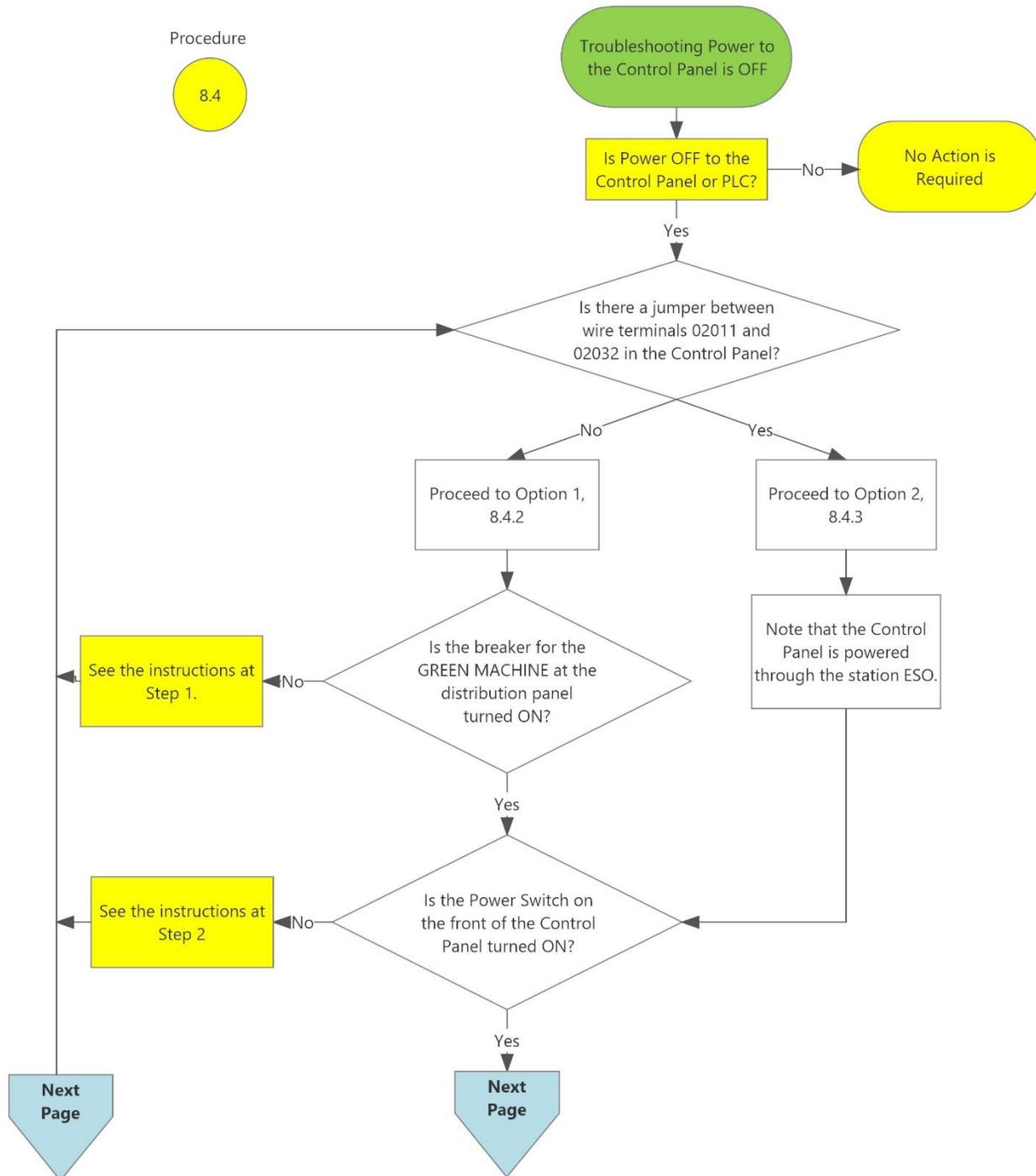
### 8.3 Troubleshooting Procedures

- Each of the following Troubleshooting Procedures is preceded by a Decision Tree.
  - The tree itself is a high-level overview of the required steps.
  - The steps themselves are fleshed out in greater detail immediately following the Decision Tree.
- If there are any questions or concerns while performing these Troubleshooting Procedures, contact VST at 937-704-9333.



## 8.4 Power to the VST Control Panel or PLC Controller is OFF

### Power to the Control Panel or the Controller is OFF



Power to the Control Panel is OFF, Pg 1, 3-8-2018

Figure 8-4: Power to the VST Control Panel or Controller is OFF



Power to the Control Panel or the Controller is OFF, continued...

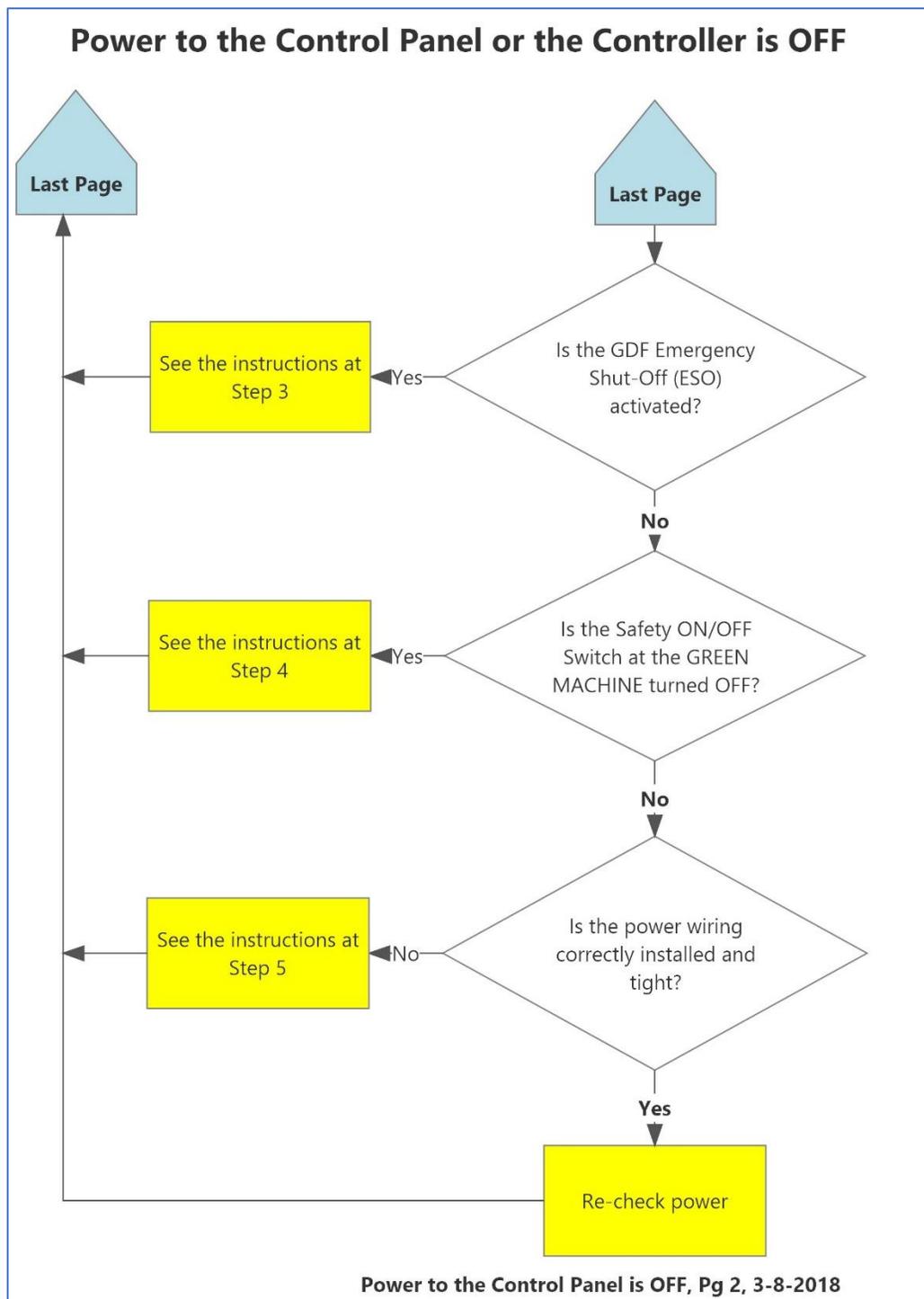


Figure 8-4 continued... Power to the VST Control Panel or Controller is OFF



### 8.4.1 Control Panel General Information

- The VST Control Panels are pre-wired and tested prior to leaving the factory.
- Check all wiring connections to make sure they are properly connected.
- The VST Control Panel is MET Listed to comply with UL Standard 508A, and CSA C22.2 No.14.
- If an electrical component has malfunctioned inside the VST Control Panel, all the electrical components **MUST BE** ordered from the Replacement Parts List (Chapter 9) in this manual.
- Check the wire terminals 02011 and 02032, then proceed to the appropriate procedures:
  - Option 1:** If there are two wires landed in these terminals, the VST Control Panel is powered directly from the distribution panel. See Section 8.4.2.
  - Option 2:** If there is a jumper connecting these terminals, the VST Control Panel is powered through an ESO breaker. See Section 8.4.3.



## 8.4.2 Option 1: Control Panel is Powered from Distribution Panel

Steps	Procedures
1.	Verify that the Breaker for the VST Control Panel in the main power distribution panel is ON. If not, turn the breaker ON. <b>See Figures 8-5 &amp; 8-6</b>
2.	Check that the Power Switch on the front of the Control Panel is ON. If not, turn it ON. <b>See Figure 8-9.</b>
3.	The VST Control Panel must supply 115 VAC power through an Emergency Shut-Off (ESO) dry relay for the VST Control Panel to have power and for the GREEN MACHINE to operate. <b>See Figures 8-5 &amp; 8-6.</b> <ul style="list-style-type: none"><li data-bbox="427 762 1198 789">a) Verify the VST Control Panel is connected to the station ESO.</li><li data-bbox="427 842 1398 905">b) Verify the ESO is not engaged. If the ESO is engaged the GREEN MACHINE will not have 115 VAC power.</li><li data-bbox="427 957 1344 1020">c) Verify all the wire connections from the VST Control Panel to the ESO are correct and tight.</li><li data-bbox="427 1041 1409 1136">d) Verify the ESO circuit has 115 VAC power from the VST Control Panel across terminals 02011 and 02032 on the field connections section of the VST Control Panel. <b>See Figure 8-6.</b></li><li data-bbox="427 1188 1409 1251">e) Verify that the 115 VAC Over/Under Voltage Relay is adjusted to 118 VAC or at the local voltage. <b>See Figure 8-10.</b></li></ul>
4.	Check to see if the Safety Disconnect Switch at the GREEN MACHINE is turned ON. If not, turn ON the switch. If the switch has a Lockout/Tagout lock, do not remove the lock and leave the switch OFF. Someone is performing maintenance.



Option 1: Control Panel is powered from Distribution Panel, continued...

5. Check that there is power at the VST Control Panel and the wiring is installed correctly and tight. **See Figure 8-10.**
  - Verify that the VST Control Panel fuses and wiring to power supply are correct.
    - a) With power OFF to the VST Control Panel, check to see if the 24 VDC power supply FU 4 fuse is functioning by checking continuity. The 5-amp fuse may be blown. If so replace the fuse.
    - b) With the power ON to the VST Control Panel, verify there is 24 VDC power out of the 24 VDC power supply. On the 24 VDC power supply, check the OUTPUT terminals marked -V and +V. The voltage should be  $24 \pm 5$  VDC. The 24 VDC power supply may be damaged. If so replace the 24 VDC power supply.
    - c) With the power ON to the VST Control Panel, check the 24 VDC wire connections to the GREEN MACHINE Controller. At the PLC Controller, check to make sure there is 24 VDC power across wire numbers 02092 and the ground. The PLC Controller may be damaged. If so replace the PLC Controller.
  - If the VST Control Panel worked prior to this issue after checking STEPS 1-5, and the Control Panel still does not have power, call a VST Service Technician.
  - Troubleshoot the VST Control Panel by checking the power circuit to make sure none of the electrical components are damaged.
  - The parts can be found under the Control Panel Replacement Parts List. These parts can be purchased from VST or a distributor, but they must be identical to the parts listed.
  - See the Control Panel Parts Replacement Table in Chapter 9.
    - 115 VAC 20A Motor Circuit Controller
    - 115 VAC Side Mount Aux. Contact N.O.
    - Solid State Relay, 30A, SPST, 90-280V INPUT, N.O., 24-280 VAC LOAD
    - 115 VAC Over/Under Voltage Relay



### 8.4.3 Option 2: Control Panel is Powered from ESO Breaker

Steps	Procedures
1.	Note that the VST Control Panel is powered through the ESO breaker. <b>See Figures 8-7 &amp; 8-8.</b>
2.	Check that the Power Switch on the front of the Control Panel is ON. If not, turn it ON. <b>See Figure 8-9.</b>
3.	The VST Control Panel must be supplied 115 VAC power through an Emergency Shut-Off (ESO) dry relay for the VST Control Panel to have power and for the GREEN MACHINE to operate. <b>See Figures 8-7 &amp; 8-8.</b> <ul style="list-style-type: none"><li data-bbox="427 762 1198 789">a) Verify the VST Control Panel is connected to the station ESO.</li><li data-bbox="427 842 1398 905">b) Verify the ESO is not engaged. If the ESO is engaged the GREEN MACHINE will not have 115 VAC power.</li><li data-bbox="427 957 1344 1020">c) Verify all the wire connections from the VST Control Panel to the ESO are correct and tight.</li><li data-bbox="427 1073 1377 1167">d) Verify the ESO circuit has 115 VAC power from the VST Control Panel across terminals 02011 and 02032 by checking the continuity of the jumper. <b>See Figure 8-8.</b></li><li data-bbox="427 1251 1409 1356">e) Verify that the 115 VAC Over/Under Voltage Relay is adjusted to 118 VAC or at the local voltage. <b>See Figure 8-10.</b></li></ul>



Option 2: Control Panel is powered from ESO Breaker, continued...

4. Check to see if the Safety Disconnect Switch at the GREEN MACHINE is turned ON. If not, turn ON the switch. If the switch has a Lockout/Tagout lock, do not remove the lock and leave the switch OFF. Someone is performing maintenance.
5. Check that there is power at the VST Control Panel and the wiring is installed correctly and tight. **See Figure 8-10.**
  - Verify that the VST Control Panel fuses and wiring to power supply are correct.
    - a) With power OFF to the VST Control Panel, check to see if the 24 VDC power supply FU 4 fuse is functioning by checking continuity. The 5-amp fuse may be blown. If so replace the fuse.
    - b) With the power ON to the VST Control Panel, verify there is 24 VDC power out of the 24 VDC power supply. On the 24 VDC power supply, check the OUTPUT terminals marked -V and +V. The voltage should be  $24 \pm 5$  VDC. The 24 VDC power supply may be damaged. If so replace the 24 VDC power supply.
    - c) With the power ON to the VST Control Panel, check the 24 VDC wire connections to the GREEN MACHINE Controller. At the PLC Controller, check to make sure there is 24 VDC power across wire number 02092 and the ground. The PLC Controller may be damaged. If so replace the PLC Controller.
  - If the VST Control Panel worked prior to this issue after checking STEPS 1-5, and the Control Panel still does not have power, call a VST Service Technician.
  - Troubleshoot the VST Control Panel by checking the power circuit to make sure none of the electrical components are damaged.
    - The parts can be found under the Control Panel Replacement Parts List. These parts can be purchased from VST or a distributor, but they must be identical to the parts listed.
    - See the Control Panel Parts Replacement Table in Chapter 9.
      - 115 VAC 20A Motor Circuit Controller
      - 115 VAC Side Mount Aux. Contact N.O.
      - Solid State Relay, 30A, SPST, 90-280V INPUT, N.O., 24-280 VAC LOAD
      - 115 VAC Over/Under Voltage Relay

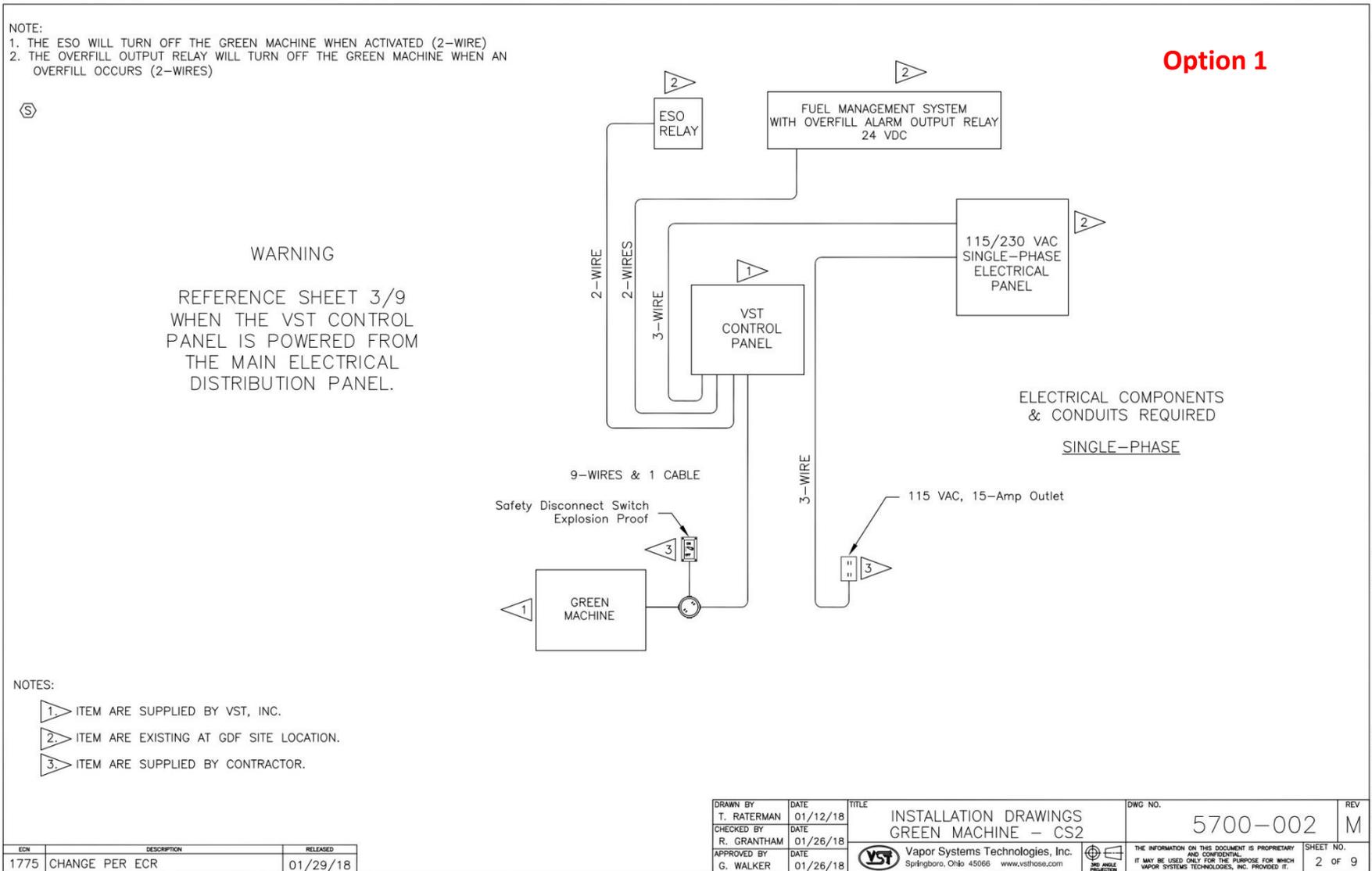


Figure 8-5: Electrical Field Wiring Diagram



**Option 1**

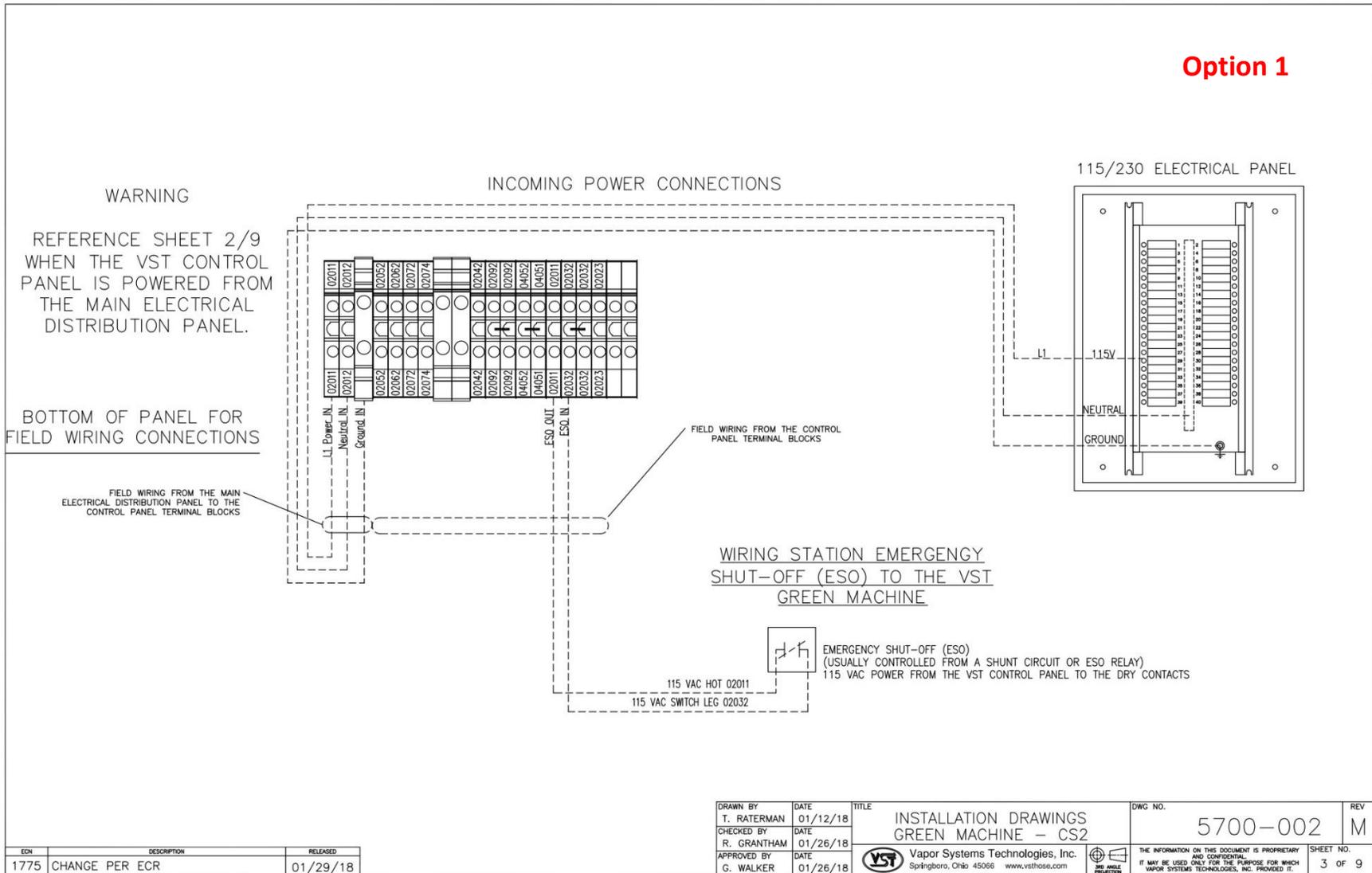


Figure 8-6: Incoming Power Connections

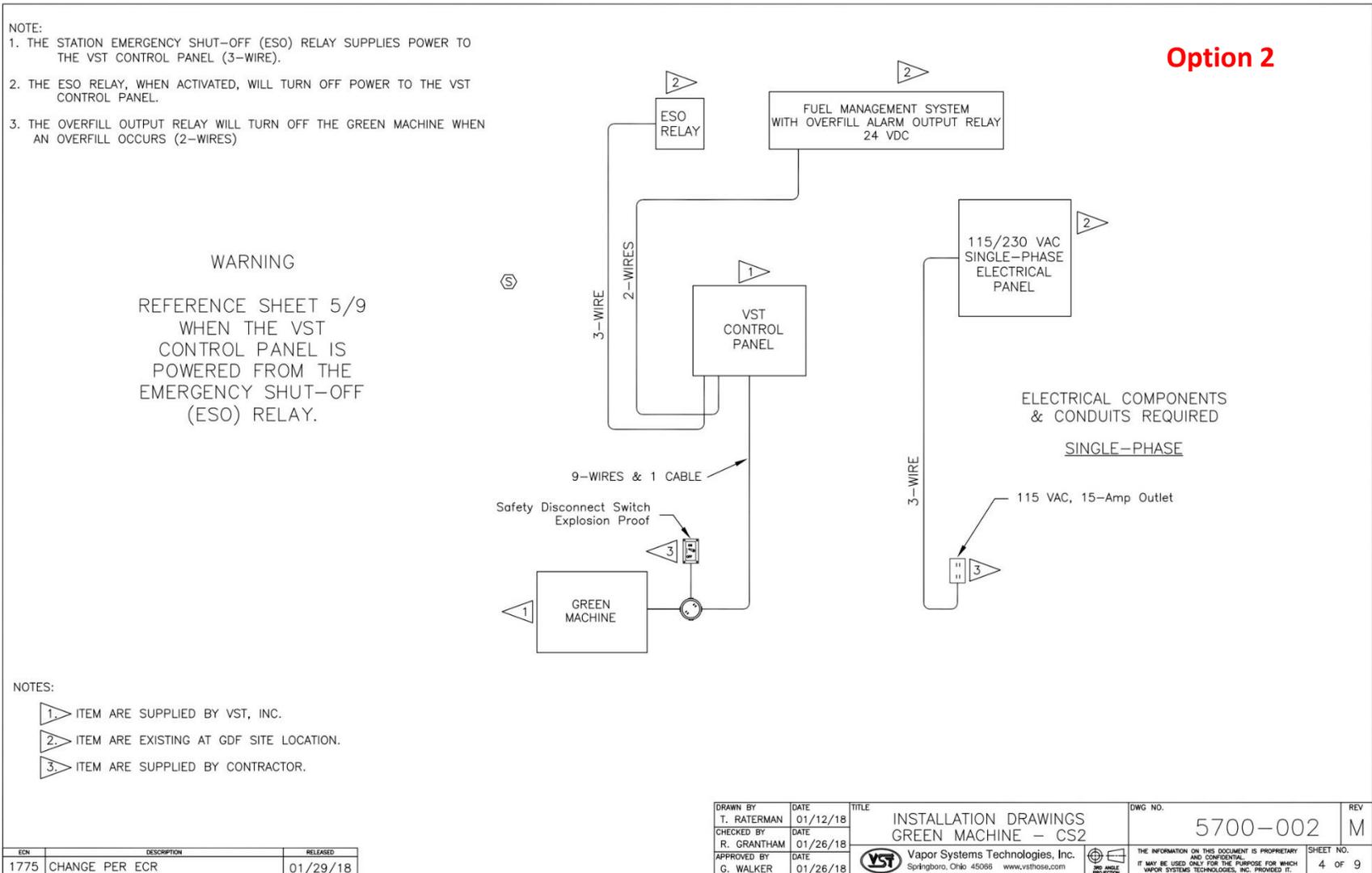


Figure 8-7: VST Control Panel Powered from ESO Relay

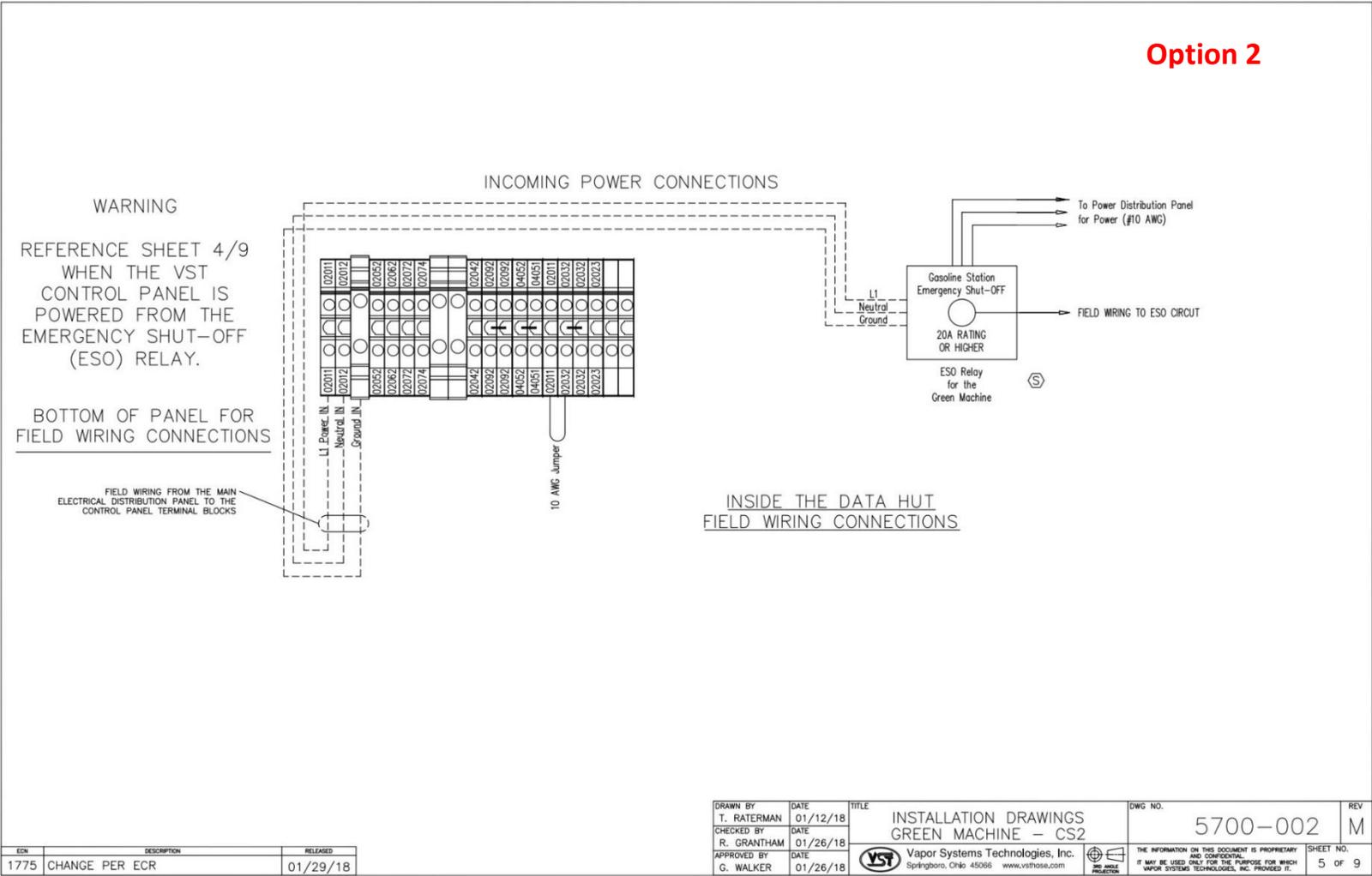


Figure 8-8: Electrical Overview Installation Drawing

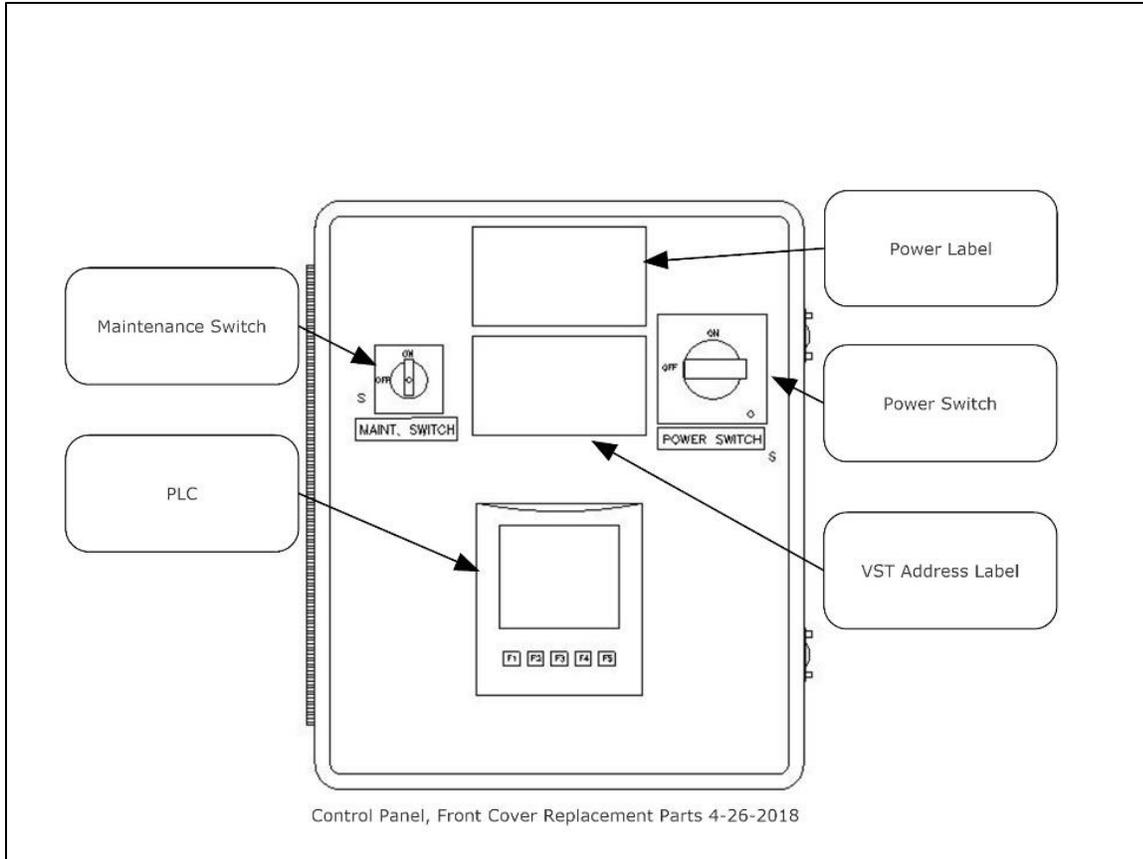


Figure 8-9: VST Control Panel Components – Front Cover

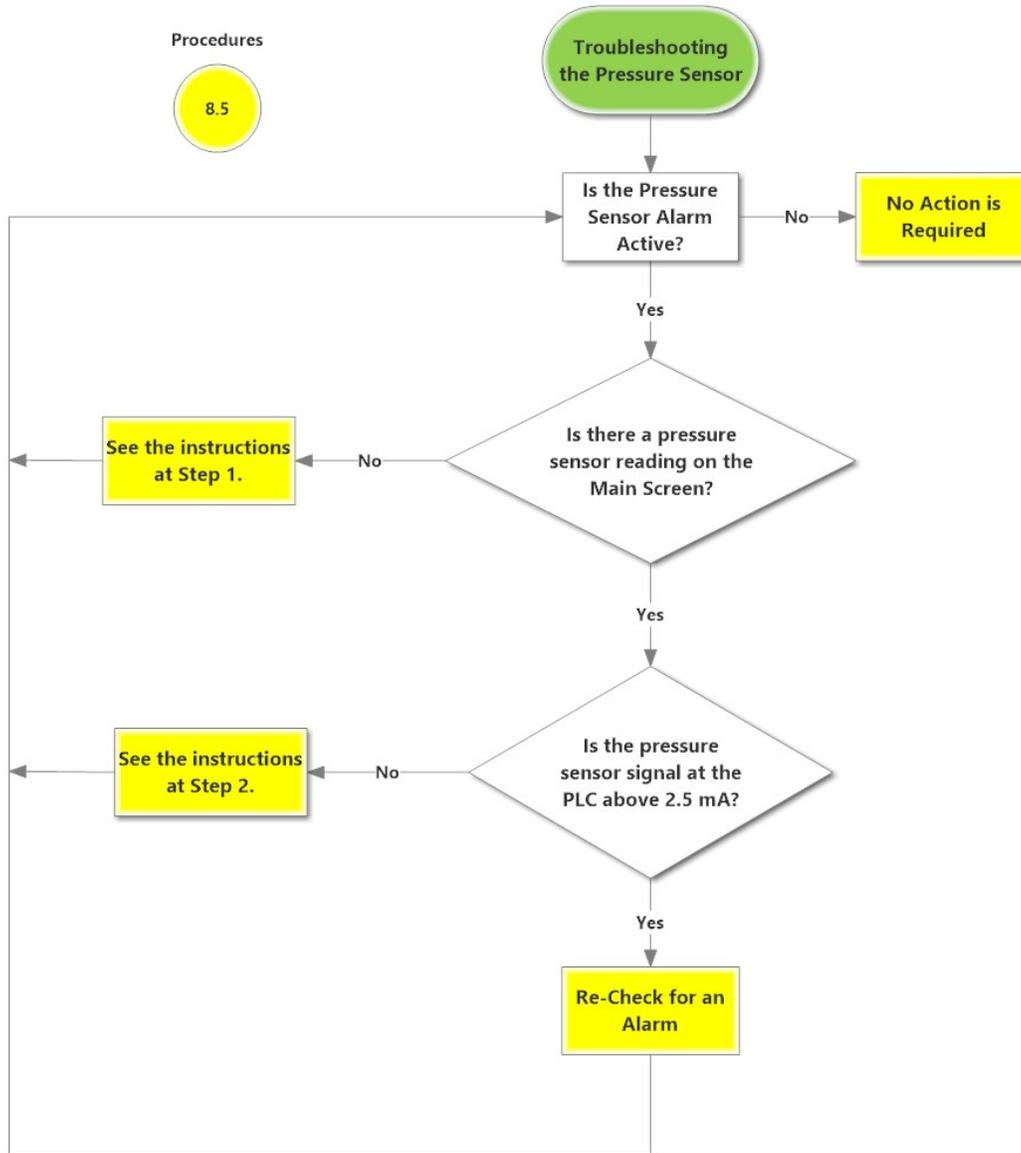




## 8.5 Pressure Sensor Alarm

- A Pressure Sensor Alarm will occur if the PLC is not receiving a 4-20 mA input from the Pressure Sensor, or the mA reading is less than 2.5 mA or if there is not 24 VDC power to the Pressure Sensor. **See Figure 8-11.**

### Pressure Sensor Troubleshooting



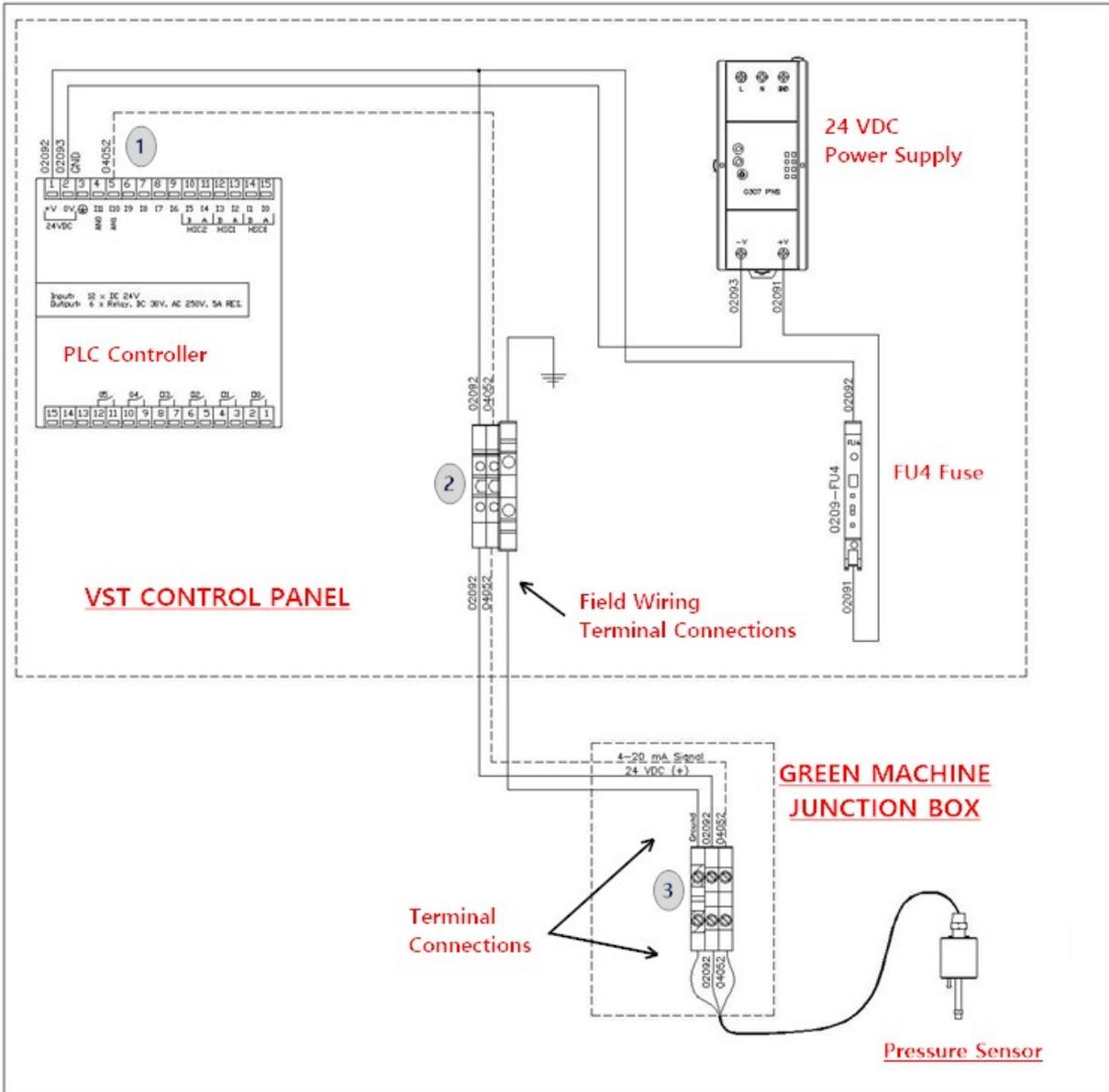
Pressure Sensor Troubleshooting, 3-5-2019

Figure 8-11: Pressure Sensor Alarm Troubleshooting Procedure



### 8.5.1 Pressure Sensor Alarm: Troubleshooting Steps

Steps	Procedures
	<ol style="list-style-type: none"><li>1. Check that a Pressure Sensor reading is showing on the Main Screen.<ul style="list-style-type: none"><li>• If a Pressure Sensor reading is showing on the Main Screen, go to Step 2.</li><li>• If a Pressure Sensor reading is not showing:<ol style="list-style-type: none"><li>a) There is no 24 VDC power to the Pressure Sensor circuit.</li><li>b) There is no signal from the Pressure Sensor at the PLC.</li><li>c) Check the Pressure Sensor power circuit as shown in <b>Figure 8-12</b>.</li><li>d) Repair the Pressure Sensor power circuit as needed.</li><li>e) If the power and signal circuits are OK, replace the Pressure Sensor.</li></ol></li></ul></li><li>2. Verify the Pressure Sensor signal at the PLC is below 2.5 mA. <b>See Figure 8-12.</b><ol style="list-style-type: none"><li>a) Remove wire 04052 from the PLC, then using a multimeter, check the current between wire 04052 and AN1 on the PLC.</li><li>b) If the signal is zero or below 2.5 mA, check to make sure the Pressure Sensor circuit wiring is correct and tight, then see Chapter 9: Replacement Procedure to replace the Pressure Sensor.</li></ol></li></ol> <ul style="list-style-type: none"><li>• If the Pressure Sensor Alarm is still active after repairing Items 1-2, call a VST Service Technician.</li></ul>



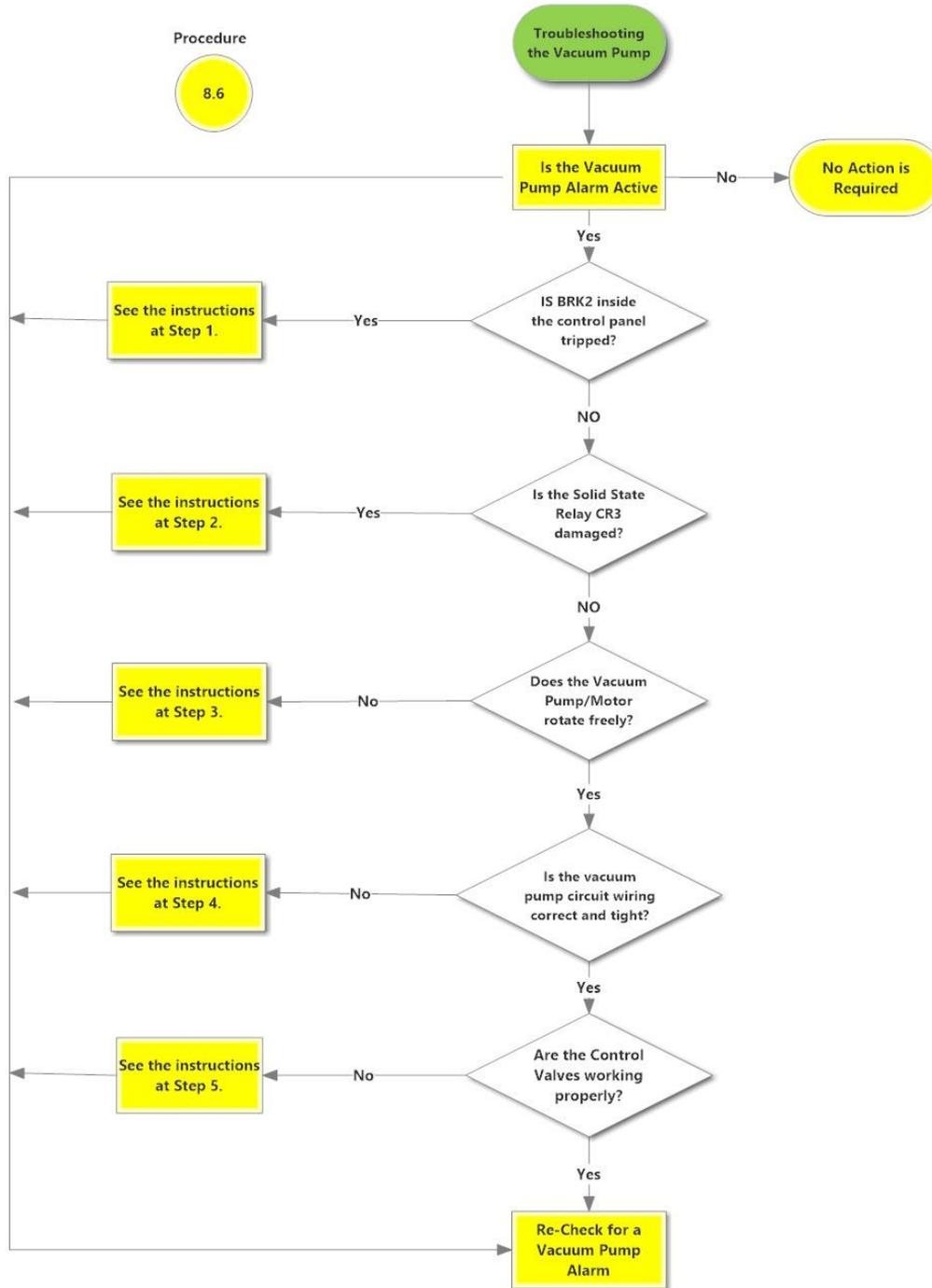
Pressure Sensor Wiring Diagram, 3-5-2019

Figure 8-12: Pressure Sensor Wiring Diagram (24VDC Power and 4-20 mA Signal)



## 8.6 Vacuum Pump Alarm

### Vacuum Pump Alarm



Vacuum Pump Motor Alarm, 3-8-2018

Figure 8-13: Vacuum Pump Troubleshooting Procedures



## 8.6.1 Vacuum Pump Alarm: Troubleshooting Steps

Steps	Procedures
<b>1.</b>	<p><b>Check to see if the Vacuum Pump breaker (BKR2) in the Control Panel has tripped. See Figure 8-14.</b></p> <ul style="list-style-type: none"><li>a) Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel. (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE).</li><li>b) Follow lockout &amp; tagout procedures prior to starting work.</li><li>c) Open the Control Panel front door</li><li>d) Check the breaker BRK2 to see if it tripped:<ul style="list-style-type: none"><li>● If the breaker lever is up and the window is RED, the breaker has not tripped.</li><li>● If the breaker lever is down and the window is GREEN, the breaker has tripped.</li></ul></li><li>e) If the breaker has not tripped, go to Step 2.</li><li>f) If the Vacuum Pump breaker has tripped, move the lever up to reset the breaker.</li><li>g) Close the Control Panel front door.</li><li>h) Turn on the Power Switch on the front of the Control Panel and re-install the carabiner clip. The PLC will turn ON in the Main Screen.</li><li>i) Push the Maintenance button on the PLC touch screen.</li><li>j) Enter 878 then push the return button.</li><li>k) You will now be in the Maintenance Screen.</li><li>l) The Reset Motor Alarm button will be RED. Push the Reset Motor Alarm button so the alarm resets.</li><li>m) Push ESC on the PLC to go back to the Main Screen and the alarm will be cleared.</li><li>n) The GREEN MACHINE is now in a Normal Operating Mode and will operate if the UST pressure is above 0.2 IWC.</li><li>o) NOTE: IF THE VACUUM PUMP BREAKER CONTINUES TO TRIP, GO TO STEP 2.</li></ul>



## Troubleshooting Procedures, continued

Steps	Procedures
-------	------------

**2. Check to see if the Vacuum Pump Solid State Relay is damaged.**

- a) Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel. (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE.
- b) Follow Lockout/Tagout procedures prior to starting work.
- c) Open the Control Panel front door.
- d) Turn the Power Switch on the inside of the Control Panel to the ON position.  
**\*\*CAUTION: You are now working in a hot panel\*\***
- e) Push the Maintenance button on the PLC touch screen.
- f) Enter 878 then push the return button.
- g) Push the Reset Motor Alarm button to reset the motor alarm. Without resetting the alarm, you will not be able to do the next step.
- h) Push the Manual ON button. This button runs the GREEN MACHINE which allows you to check the voltage on each of the terminals of the solid-state relay. See the table below for expected voltage values of each terminal.

i)

Wire Number	Terminal Location	Expected Voltage
02051A	Top Left to 115 VAC ground	~120 VAC
02052	Top Right to 115 VAC ground	~120 VAC
02093 05051	Bottom Left to Bottom Right	~24 VDC
05051	Bottom Right to 24 VDC ground	~24 VDC

- j) If any of the voltages are not correct, check the associated breakers, fuses, and wiring for proper connections. If the voltages are correct, go to Step m).
- k) If the wiring connections are all tight, replace the relay. Note the wire numbers and location.
- l) After the relay is replaced, close the Control Panel front door. Go to Step h) to retest.
- m) Turn OFF the Power Switch inside the Control Panel.
- n) Close and latch the Control Panel door.
- o) Turn ON the Power Switch on the front of the Control Panel and re-install the carabiner clip. The PLC will turn ON in the Main Screen.
- p) Push the Maintenance button on the PLC touch screen.
- q) Enter 878 then push the return button.
- r) You will now be in the Maintenance Screen.
- s) The Reset Motor Alarm button will be RED. Push the Reset Motor Alarm button so the alarm resets.
- t) Push ESC on the PLC to go back to the Main Screen and the Alarm will be cleared.
- u) The GREEN MACHINE is now in a Normal Operating Mode and will operate if the UST pressure is above 0.2 IWC.
- v) NOTE: IF THE VACUUM PUMP CONTINUES TO ALARM, GOTO STEP 3



## Vacuum Pump Alarm: Troubleshooting Steps, continued...

Steps	Procedures
<b>3. Check to see if the Vacuum Pump/motor rotates freely.</b>	<ul style="list-style-type: none"><li>• Physically check the Vacuum Pump to make sure the pump, motor, and drive couplings are functioning correctly.</li><li>a) Remove the carabiner clip and turn the Power Switch on the front of the VST Control Panel OFF.</li><li>b) At the GREEN MACHINE, turn OFF the Safety Disconnect Switch.</li><li>c) Use Lockout/Tagout Safety procedure.</li><li>d) Remove the cover on the GREEN MACHINE.</li><li>e) Remove the fan guard over the Vacuum Pump / motor drive coupling.</li><li>f) Turn the motor/Vacuum Pump by hand to see if it is seized (cannot rotate).</li><li>g) If you cannot turn the shaft between the pump and the motor, loosen the set screws on the motor side of the rubber flange sleeve and slide the coupling towards the motor.</li><li>h) Turn both the motor and Vacuum Pump sides of the shaft.</li><li>g) If the Vacuum Pump is seized, REPLACE THE VACUUM PUMP.</li><li>h) If the motor is seized, REPLACE THE VACUUM PUMP MOTOR.</li><li>i) If the drive coupling rubber flange sleeve is damaged or jammed, or if you replace either the Vacuum Pump or the Vacuum Pump motor, REPLACE THE RUBBER FLANGE SLEEVE.</li><li>j) See Chapter 9 for Replacement Parts Procedures.</li><li>n) Push the Maintenance button on the PLC touch screen.</li><li>o) Enter 878 then push the return button.</li><li>p) You will now be in the Maintenance Screen.</li><li>q) The Reset Motor Alarm button will be RED. Push the Reset Motor Alarm button so the alarm resets.</li></ul>



Vacuum Pump Alarm: Troubleshooting Steps, continued...

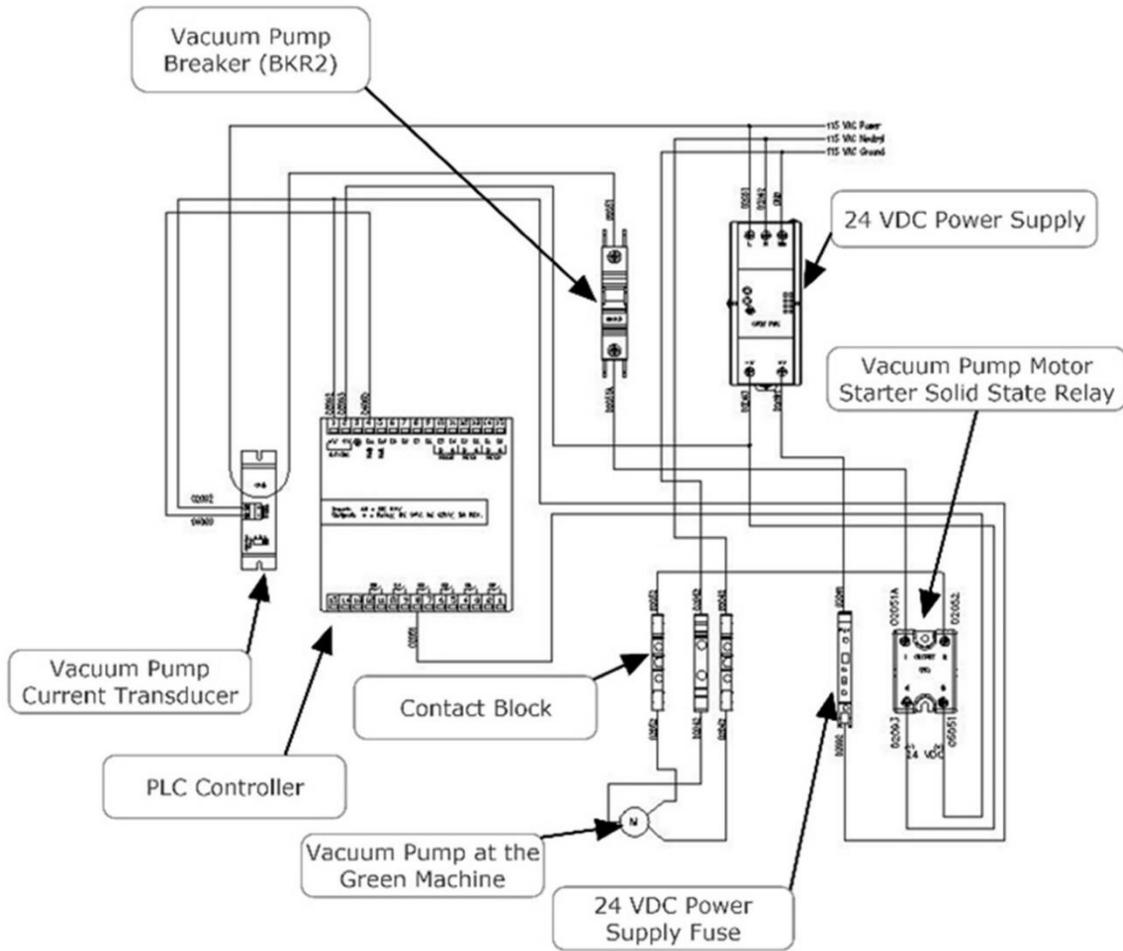
Steps	Procedures
<p><b>4. Check the Vacuum Pump wiring circuit inside the VST Control Panel.</b> <b>See Figure 8-14.</b></p>	<ul style="list-style-type: none"><li>• Physically check the Vacuum Pump wiring connections at the Vacuum Pump junction box and at the VST Control Panel to make sure the connections are tight and wired correctly.</li></ul>
<p><b>5. Check the Control Valves</b></p>	<ul style="list-style-type: none"><li>• Control Valve Operation Check – <b>See Figures 8-15 &amp; 8-16.</b></li><li>• Check the operation of the control valves (A thru E) to see if any of the control valves have malfunctioned. A malfunctioned control valve may cause the Vacuum Pump motor to trip out on thermal overloads.</li><li>• <b>Purpose of the Test</b><ul style="list-style-type: none"><li>• The purpose of this test is to check to see if there is power at the control valves and the control valves are working properly.</li><li>• This test is also used for the Leak Check.</li><li>• When the F1 button is pushed, all the control valves are energized (open), which will allow the technician to see if all 5 of the control valves have power and are working. (The Vacuum Pump will not run.)</li></ul></li><li>• <b>Preparation</b><ul style="list-style-type: none"><li>• Make sure power is ON to the VST Control Panel.</li><li>• At the Main Screen, push the Maintenance button to access the Password Screen.</li><li>• Enter the password 878 to access the Maintenance Screen.</li><li>• The GREEN MACHINE is now in the OFF mode and will not operate.</li><li>• Push the Reset Motor Alarm button to reset the motor alarm. Without resetting the alarm, you will not be able to do the next step.</li></ul></li></ul>



## Vacuum Pump Alarm: Troubleshooting Steps, continued...

- **Procedure**

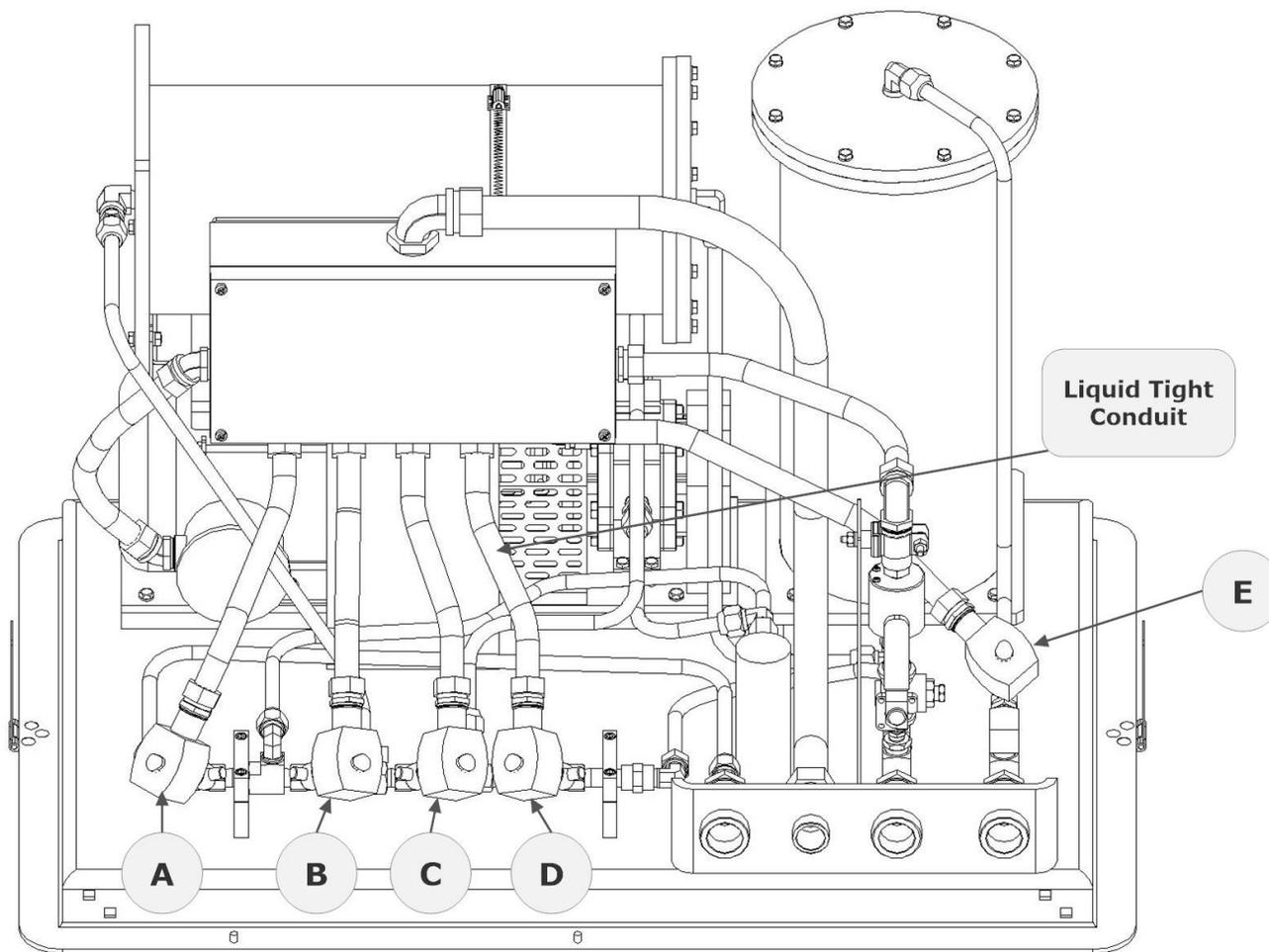
1. To start the test, push the F1 button on the Maintenance Screen. Press the Start Button to energize all the control valves.
2. Check for a magnetic field at the retaining clip in the center of the valve operator.
  - a) Take a small non-magnetized screwdriver that will be drawn to the magnetic field, if one is present, and see if the screwdriver is drawn to the general location of the retainer clip.
  - b) If a valve is not energized, the screwdriver will not be drawn to the retainer clip.
    - If valve A or C and fuse FU2 has 115 VAC power and is not energized, replace the bad valve core.
    - If valve B or D and fuse FU3 has 115 VAC power and is not energized, replace the bad valve core.
    - If valve E and fuse FU5 has 115 VAC power and is not energized, replace the bad valve core.
  - c) If the magnetic fields are present, listen for any of the control valves making a chattering sound. If chattering is heard, replace the valve core.
  - d) Replace the valve core using the Core Rebuilt Kit as shown in the Replacement Parts Section. See Chapter 9 for Replacement Parts Procedures.
3. After checking and replacing the Control Valves, push the F4 button to return to the Maintenance Screen.
4. At the GREEN MACHINE Controller, push the ESC button to return to the Main Screen where the GREEN MACHINE will go into a Normal Operating mode.



Vacuum Pump Power and Control Circuit, 3-9-2018

Figure 8-14: Vacuum Pump Power and Control Circuit





GM Dual Canister Control Valve Replacement Diagram, 09-20-2019

Figure 8-16: GREEN MACHINE isometric with Control Valves Identification Labels



## 8.7 Maintenance Switch Alarm

- The Maintenance Switch Alarm will activate when the Maintenance Switch has been turned OFF. The Maintenance Switch is used to stop the GREEN MACHINE from running, which will keep power ON to the Control Panel and to the PLC Controller.
- This function is usually used if there is a problem with the GREEN MACHINE and is used during troubleshooting.
- **See Figure 8-9.**

### **When the Maintenance Switch Alarm is Active:**

1. On the Main Screen, the GM Status text box will turn RED and display ALARM.
2. Push the Alarm Screen button to view the Alarm Screen.
3. The Maintenance Switch Alarm box will be RED and display Maintenance Switch Alarm.

### **To reset the Maintenance Switch Alarm:**

1. Turn the Maintenance Switch to the ON position on the front of the Control Panel.
2. The Maintenance Switch Alarm will now display Maintenance Switch Normal in a GREEN box.



## 8.8 Overfill Alarm

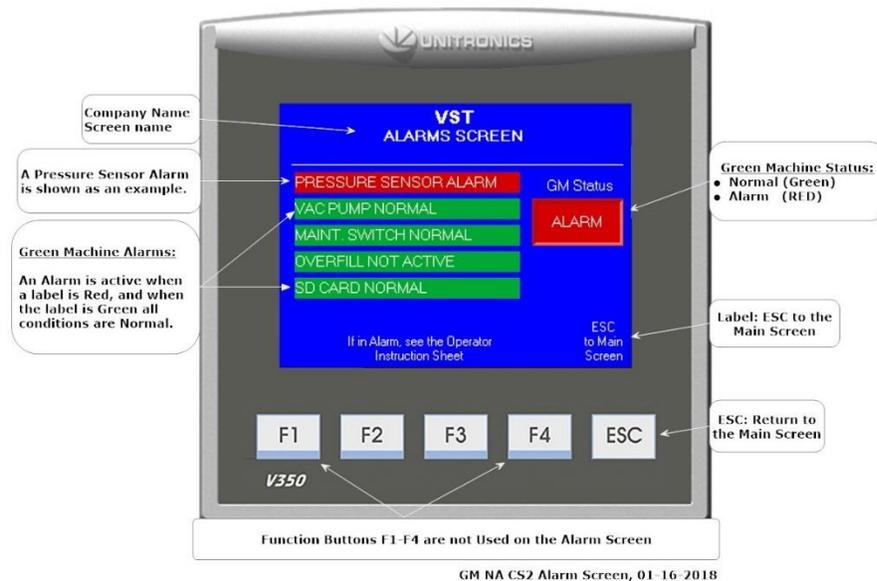


Figure 8-17: GREEN MACHINE Controller Alarm Screen

- A VST Control Panel Controller Overfill Alarm is Active when the Fuel Management System Overfill Alarm is Active. **See Figure 8-17.**
- An overfill condition exists when, during a fuel drop, the gasoline level in the UST exceeds the Overfill Alarm setting, which is 90% capacity of the UST. **See Figure 8-18.**
  - The VST Control Panel is connected to the Tank Overfill Alarm output relay.
  - When an overfill occurs, the output (N.O.) relay closes and GREEN MACHINE will turn OFF.
  - The Overfill Alarm box will display RED indicating an Overfill Alarm is active.
  - When the gasoline level drops below the Overfill Alarm level, the output relay opens and the alarm clears. The GREEN MACHINE will remain OFF for 2 additional hours.
  - After the 2-hours elapse:
    - The Overfill Alarm box will not be shown on the Fault and Alarm Screen.
    - The GREEN MACHINE will turn ON if the UST pressure is above 0.2 IWC.
    - The GREEN MACHINE will remain OFF if the UST pressure is below 0.2 IWC.



### 8.8.1 Overfill Alarm Troubleshooting Steps

Steps	Procedures
1. An overfill may cause the Vacuum Pump to seize, which may cause the Vacuum Pump motor to trip out on the thermal overloads.  2. If an Overfill Alarm Activates while a test is running:	<ul style="list-style-type: none"><li>• The test will terminate.</li><li>• The Fault and Alarm Screen is displayed and the Overfill Alarm box will display RED.</li><li>• An underground storage tank overfill is a serious situation that could damage internal components in the GREEN MACHINE.</li><li>• An overfill might happen if the delivery person fails to stop fueling, ignoring both the overfill limit and the high-product limit.</li><li>• VST has determined that overfill protection is needed to reduce the chance of gasoline entering the GREEN MACHINE.</li><li>• Below are the precautionary measures taken to protect the GREEN MACHINE against an overfill situation:<ul style="list-style-type: none"><li>• The VST Control Panel will disable the GREEN MACHINE when the UST level reaches the OVERFILL Alarm setting (OVERFILL: 90%) when the relay contacts close at the Fuel Management System.</li><li>• Eventually, as fuel is dispensed, the product would drop below the OVERFILL Alarm threshold thereby resetting the relay and re-enabling the GREEN MACHINE.</li><li>• The Fuel Management System OVERFILL ALARM will not guarantee that the GREEN MACHINE is protected from gasoline entering it.</li></ul></li></ul> 3. The table below lists the VST recommended alarm settings for the tank level.

Position of Tank Alarm Limits	VST Recommended Alarm Settings
Overfill Limit	90%

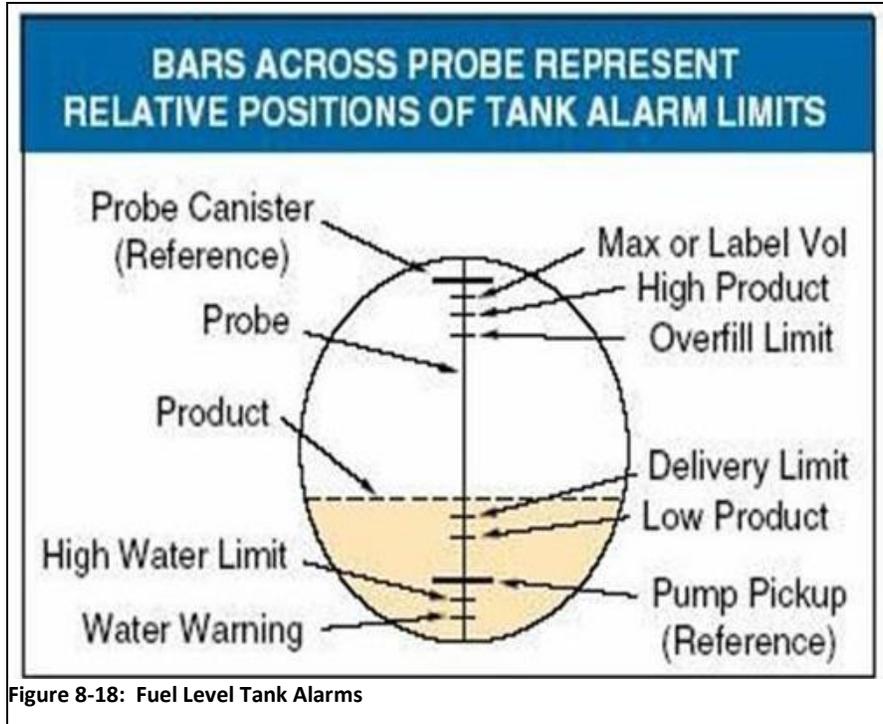


Figure 8-18: Fuel Level Tank Alarms

<b>Overfill Report</b>		
Date:		
Contractor Name:		
Contractor Company:		
GDF Name:		
Address:		
City:	State:	ZIP Code:
GDF Contact Person Name:		
GDF Contact Person Title:		
GDF Contact Person Phone:		
GDF Contact Person E-mail:		
Overfill Details		
Date of Overfill:		
Octane of the fuel being dispensed:		
Serial Number of the GREEN MACHINE:		



## 8.9 SD Card Alarm

- The GREEN MACHINE will operate when there is a SD Card Alarm, but the card will not or cannot record the data.
  
- The SD Card Alarm will activate when the following items occur:
  1. An SD Card is not installed in the Controller slot.
  2. The SD Card write protection is ON.
  3. When the SD Card is not inserted in to the slot properly.
  
- Correct the above problem(s) and the SD Card Alarm will clear.

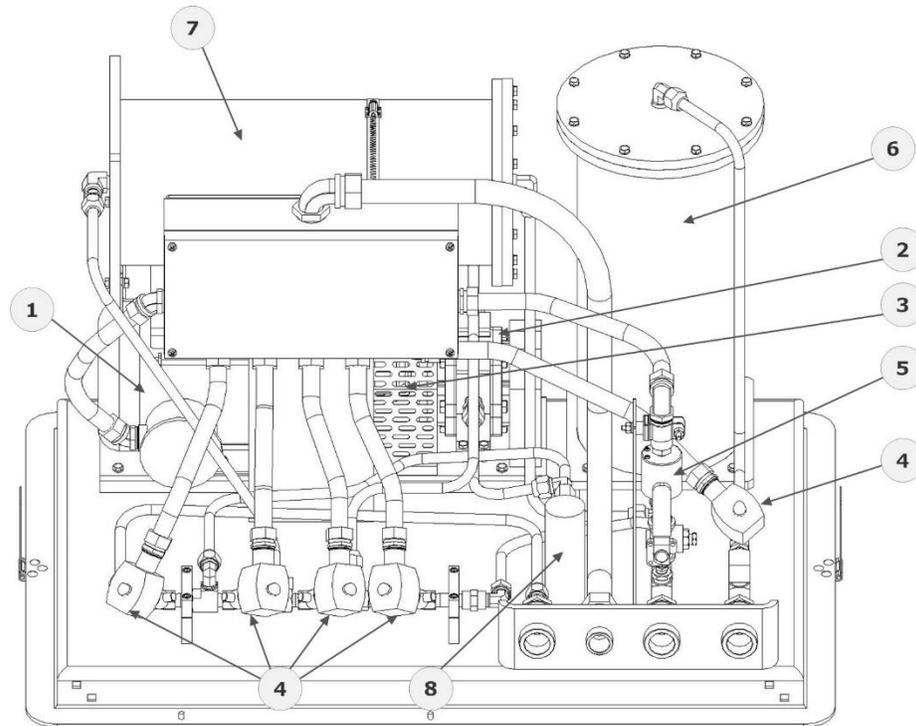


# Chapter 9: Replacement Procedures

## 9 Replacement Parts Procedures

### 9.1 List of Replacement Parts

- The GREEN MACHINE parts shown in the picture and table below must be supplied by VST. See Figure 9-1.



Green Machine Dual Canister Parts Numbering, 09-20-2019

Figure 9-1: US GREEN MACHINE Replacement Parts

VST GREEN MACHINE Replacement Parts			
Ref. #	Description	Part No.	Manufacturer
1	VACUUM PUMP MOTOR (ONLY), 115VAC, SINGLE-PHASE	GM-027	VST
2	MODEL 2 VACUUM PUMP (ONLY)	GM-022	
3	RUBBER FLANGE SLEEVE	GM-004	
4	UL CONTROL VALVES – CORE REBUILD KIT (5 each)	GM-006	
5	PRESSURE SENSOR	GM-043	
6	VAPOR FILTRATION CARTRIDGE ASSEMBLY #1	GM-035	
7	VAPOR FILTRATION CARTRIDGE ASSEMBLY #2	GM-046	
8	SEPARATOR	GM-049	



9.1.1 VST Control Panel Replacement Parts

- See Figure 9-2, 9-3, and 9-4.

VST GREEN MACHINE Replacement Parts			
Ref. #	Description	Part Number	Manufacturer
	GREEN MACHINE™ Control Panel (Complete)	GM-030	VST

VST GREEN MACHINE Control Panel (Sub-Component) Replacement Parts			
Ref. #	Description	Part Number	Manufacturer
1	GREEN MACHINE™ PLC Controller	GM-016	VST
2	8 PIN BASE SOCKET	SR2P-06	R-K ELECTRONICS
5	24VDC POWER SUPPLY, 5A	PS5R-VF24	IDEC
6	TERMINAL RELAY, 24V AC/DC, SPDT	700-HLT2U24	ALLEN BRADLEY
7	20A MOTOR CIRCUIT CONTROLLER	KTA7-25S-20A	SPRECHER+SCHUH
8	SIDE-MOUNT AUX. CONTACT 2 N.O.	KT7-PA1-20	SPRECHER+SCHUH
9	SOLID STATE RELAY, 30A, SPST, 90-280 INPUT, N.O., 24-280 VAC LOAD	AD-SSR230-22-ACR	AUTOMATION DIRECT
10	DOOR COUPLING HANDLE, RED/YEL	KT7-HTRY	SPRECHER+SCHUH
12	TERMINAL ADAPTER	KT7-25-TE1	SPRECHER+SCHUH
21	SOLID STATE RELAY, 10A, 24VDC COIL	CWD2410-10	CRYDOM
22	MINI CIRCUIT BREAKER, 15A, UL489	L9-15/1/D	SPRECHER+SCHUH
23	FUSE HOLDER	V7-H6	SPRECHER+SCHUH
24	5 A GLASS FUSE	MDL-5	BUSSMANN
25	4 A GLASS FUSE	MDL-4	BUSSMANN
26	MAINTENANCE SWITCH/HANDLE ASSEMBLY	LE2-12-1751	SPRECHER+SCHUH
34	OVER-UNDER VOLTAGE RELAY	SVM-120A-20	R-K ELECTRONICS
36	ANALOG CURRENT TRANSDUCER	H721LC	VERIS INDUSTRIES

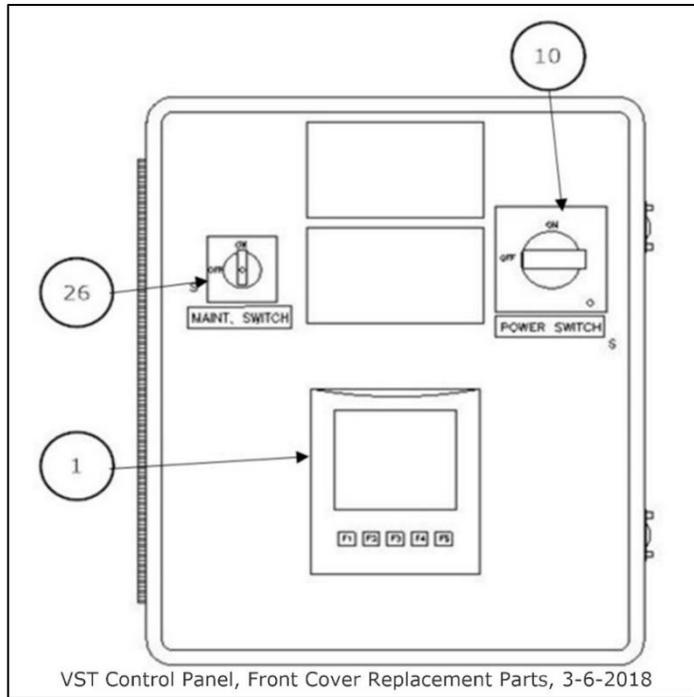


Figure 9-2: VST Control Panel, Front Cover Replacement Parts

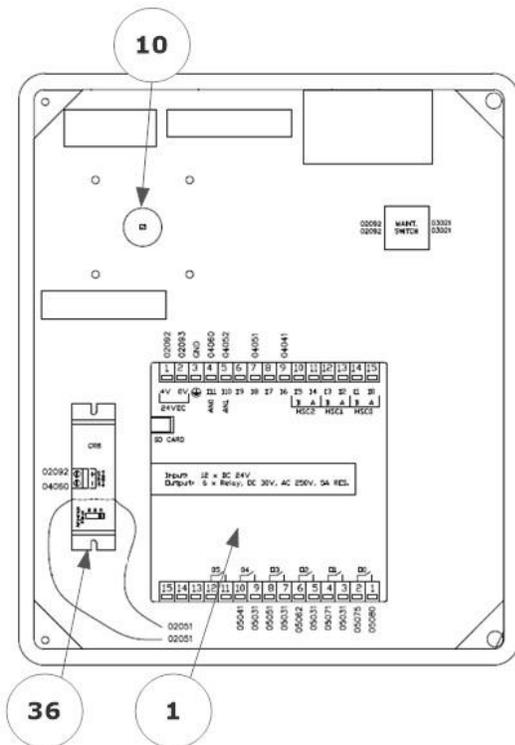
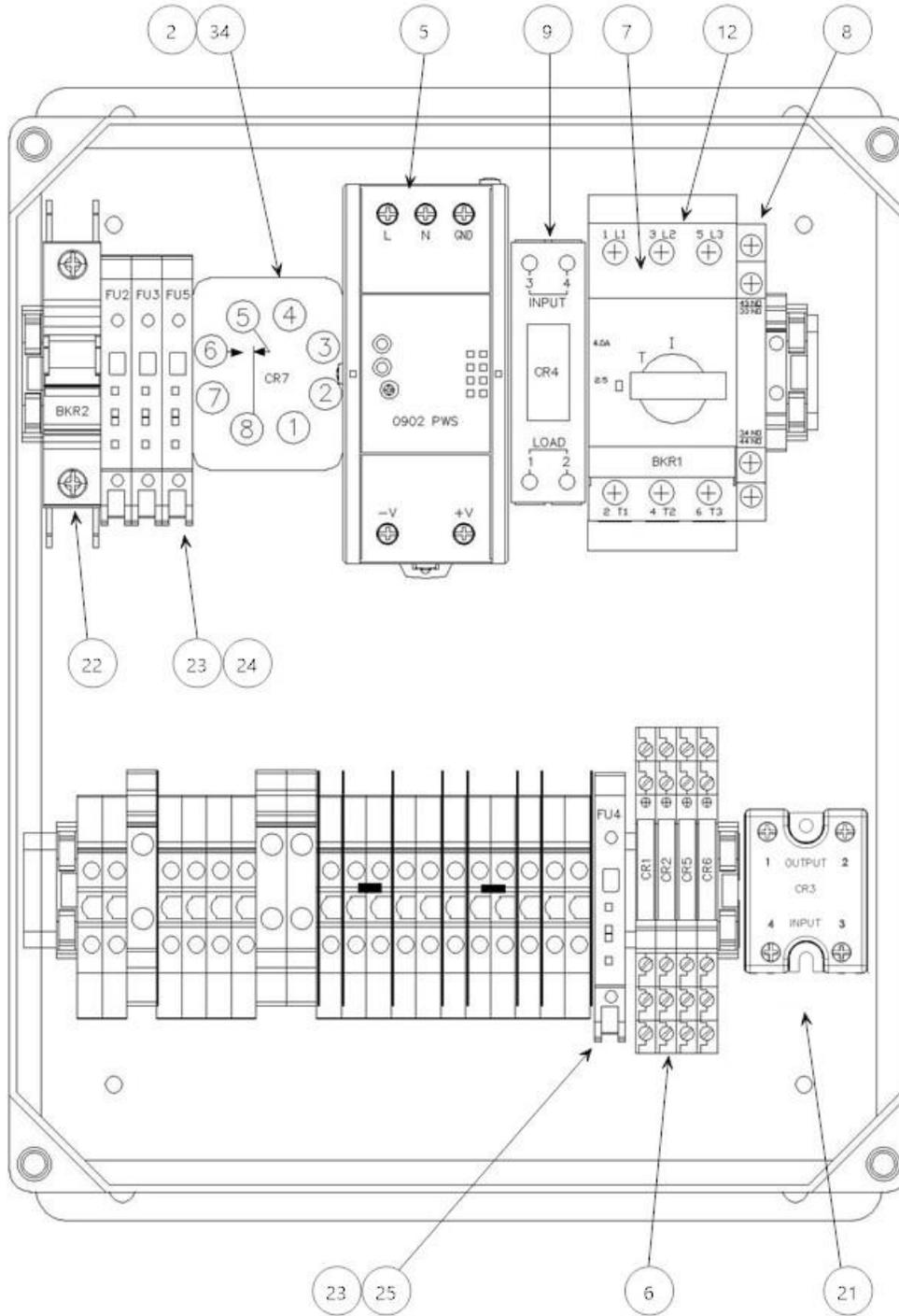


Figure 9-3: VST Control Panel, Inside the Front Cover Replacement Parts



NA GM Control Panel Inside Parts Labels, 6-20-2016

Figure 9-4: VST Control Panel, Inside Panel Replacement Parts



## 9.1.2 Replacement Procedures by Part

- 9.2 PLC (Controller) Replacement
- 9.3 Control Panel Small Components Replacement
  - 9.3.1 Vacuum Pump Motor Breaker Replacement
  - 9.3.2 Vacuum Pump Motor Solid State Relay Replacement
  - 9.3.3 Remote Monitoring System (RMS) Replacement
- 9.4 Pressure Sensor Replacement
- 9.5 Rubber Flange Sleeve Replacement
- 9.6 Vacuum Pump Motor (Only) Replacement
- 9.7 Control Valve Replacement
- 9.8 Vacuum Pump (Only) Replacement
- 9.9 Vapor Filtration Cartridge Assembly Replacement
- 9.10 Separator Replacement
- 9.11 Leak Test

## 9.2 PLC (Controller) Replacement

### Safety



Use lockout / tagout procedures prior to starting work.

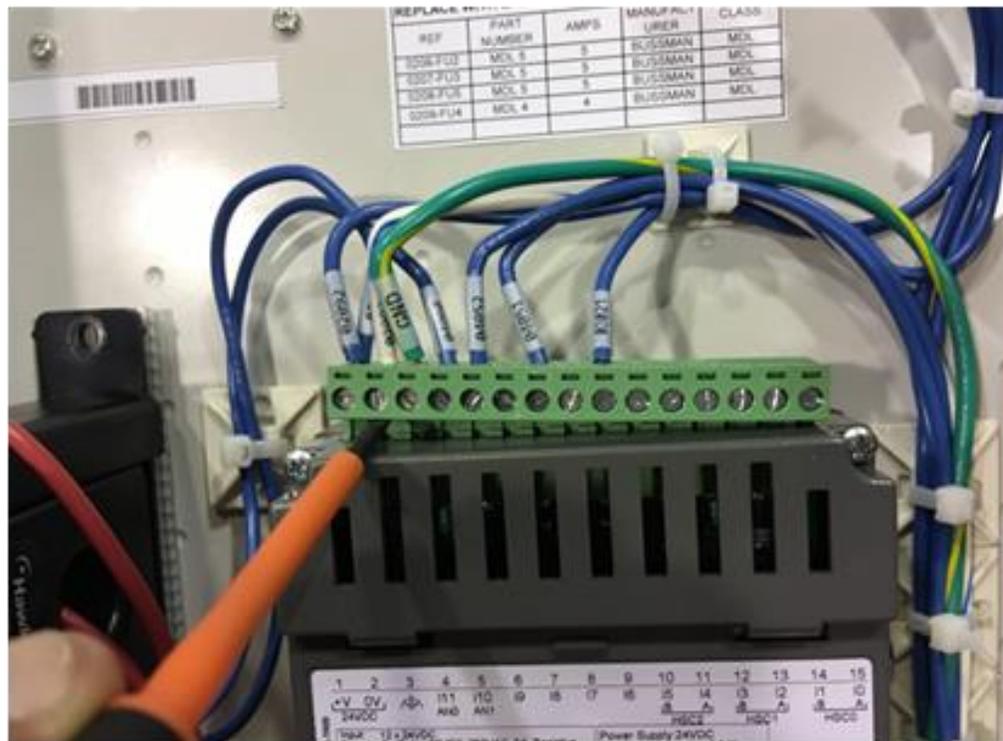
### 9.2.1 Removing the PLC

1. Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel. (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE).
2. Follow lockout & tagout procedures prior to starting work.
3. Open the VST Control Panel door for access to the PLC.
4. Loosen and remove the two terminal blocks on the top and bottom of the PLC. **DO NOT REMOVE ANY OF THE WIRES INSTALLED ON THE TERMINAL BLOCKS. See Figures 9-5 and 9-6.**
5. Loosen and remove the two hold-down clips on the sides of the PLC for removal. **See Figure 9-7.**
6. Remove the PLC from the front door of the VST Control Panel.



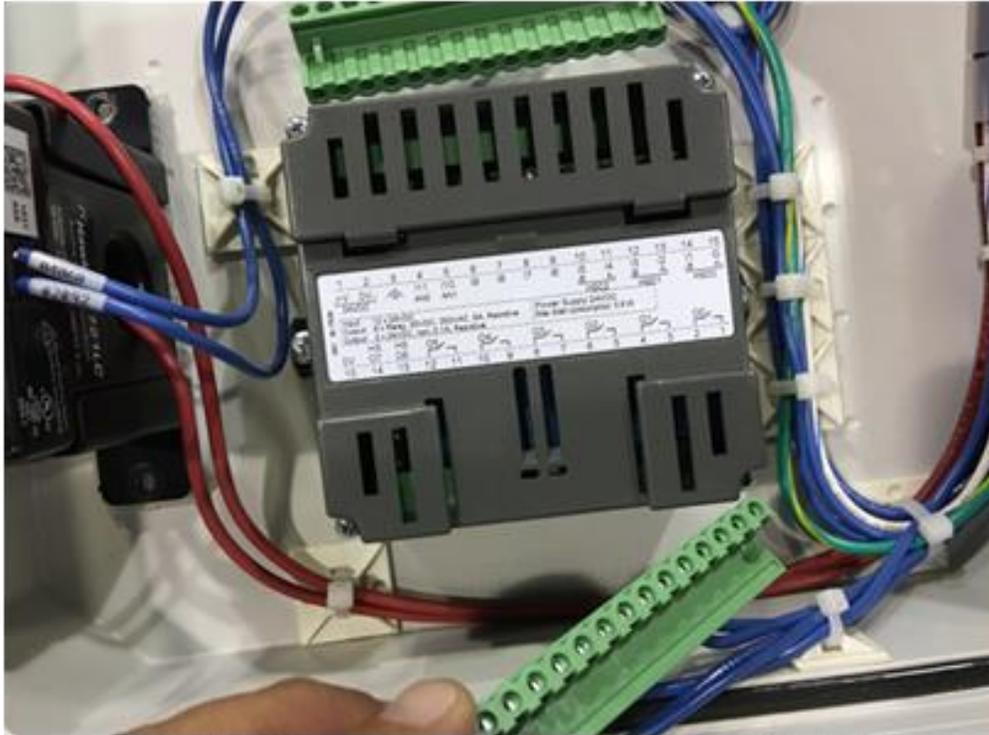
## 9.2.2 Installing the New PLC

1. Install the new PLC in the front door of the VST Control Panel in the same orientation the old PLC was removed.
2. Install the two hold-down clips on the side of the PLC and lightly tighten. Do not over tighten.
3. Reinstall the two terminal blocks on the PLC. Make sure they are fully inserted into the PLC.
4. Close the VST Control Panel door.
5. After all the work is complete, remove the lock(s) and tags from the lockout & tagout.
6. Turn ON power to the VST Control Panel. The GREEN MACHINE is now operational and will operate if the UST pressure is greater or equal to 0.20 IWC.
7. Check the VST Control Panel to make sure the Main Screen is showing.



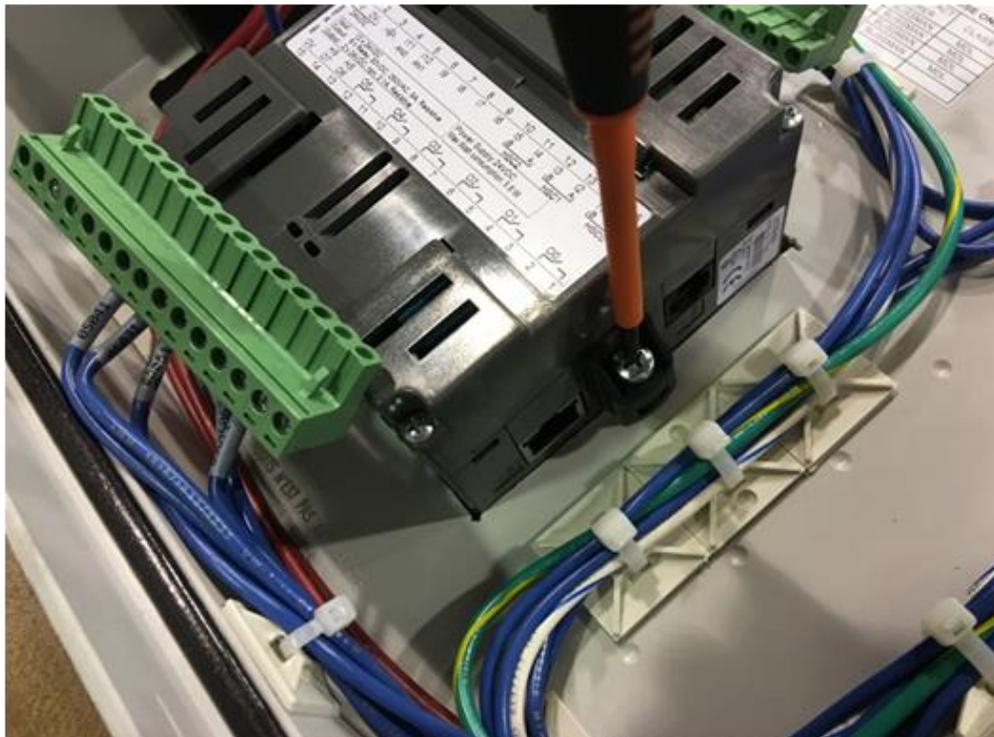
Removing the PLC Connectors, 2-28-2018

Figure 9-5: Removing the PLC Connectors



The PLC with Connectors Removed, 2-28-2018

**Figure 9-6: The PLC with Connectors Removed**



Removing the PLC Hold-Down Clips, 2-28-2018

**Figure 9-7: Removing the PLC Hold Down Clips**



Scan for Video

## 9.3 Control Panel Small Components Replacement

### 9.3.1 Vacuum Pump Motor Breaker Replacement

#### Safety



Use lockout / tagout procedures prior to starting work.

#### 9.3.1.1 Removing the Vacuum Pump Motor Breaker

- See Figure 9-2, 9-4, & 9-8.
  1. Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel (See Figure 9-2). (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE).
  2. Follow lockout & tagout procedures prior to starting work.
  3. Unlock the metal clasps on the right-hand side of the Control Panel and open the Control Panel door.
  4. Find the Vacuum Pump motor breaker (See Figure 9-4, item #22) and note the wire numbers and locations. See Figure 9-8.
  5. Using a screwdriver, loosen the two screws on the top and bottom of the breaker. Remove the two wires.
  6. Pull up on the small black release mechanism on the bottom side of the breaker and rotate the breaker out of the Control Panel.



Figure 9-8: Vacuum Pump BRK2



### 9.3.1.2 Replacing the Vacuum Pump Motor Breaker

See Figure 9-8.

1. Install the new breaker, hooking the top of the breaker on first and then pushing the bottom of the breaker down into place.
2. Using a screwdriver, reinstall the two wires.
3. Be sure the orange switch on the breaker is in the UP position. **See Figure 9-8. NOTE: The small window below the switch should be RED. If the window is GREEN, flip the switch so that the window is RED.**
4. Close the Control Panel door and lock the 2 metal clasps on the right-hand side of the Control Panel.
5. Remove locks and tags from lockout tagout.
6. Turn the Power Switch to the ON position.

### 9.3.2 Vacuum Pump Motor Solid-State Relay Replacement

Safety



Use lockout / tagout procedures prior to starting work.

#### 9.3.2.1 Removing the Solid State Relay

- **See Figures 9-2, 9-4, & 9-9.**
  1. Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel (**See Figure 9-2**). (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE).
  2. Follow lockout & tagout procedures prior to starting work.
  3. Unlock the metal clasps on the right-hand side of the Control Panel and open the Control Panel door.
  4. Find the Vacuum Pump solid-state relay (see **Figure 9-4, item #21**) and note the wire numbers and locations. **See Figure 9-9.**
  5. Using a screwdriver, remove the four wires. **See Figure 9-9.**
  6. Remove the top screw and loosen the bottom screw securing the solid-state relay to the Control Panel. The solid-state relay can now be removed by sliding up.



Figure 9-9: Vacuum Pump Solid State Relay



### 9.3.2.2 Replacing the Solid State Relay

- **See Figure 9-9.**
  1. Install the new solid-state relay, sliding it down into place onto the bottom screw.
  2. Using a screwdriver, reinstall and tighten the top screw and tighten the bottom screw.
  3. Reinstall the wires to the appropriate contacts. The bottom VDC wires must be installed as show in **Figure 9-9** because of polarity.
  4. Close the Control Panel door and lock the 2 metal clasps on the right-hand side of the Control Panel.
  5. Remove locks and tags from lockout tagout.
  6. Turn the Power Switch to the ON position.
  7. If there is an alarm on the Main Screen, refer to Vacuum Pump Alarm Troubleshooting is Section 8.6.

## 9.4 Pressure Sensor Replacement

### Safety



Use lockout / tagout procedures prior to starting work.

### 9.4.1 Removing the Pressure Sensor

- **See Figure 9-10.**
  1. Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel. (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE).
  2. Follow lockout & tagout procedures prior to starting work.
  3. Unlock the hasps and remove the cover from the GREEN MACHINE.
  4. Close the 3-way ball valve below the Pressure Sensor. (The handle is horizontal.)
  5. Remove the cover from the Internal Junction Box.
  6. Disconnect the 3 Pressure Sensor wires from the terminal block inside the Internal Junction Box. **See Figure 9-11.**
  7. Loosen and remove the Liquidtight conduit from the Internal Junction Box and at the top of the Pressure Sensor. Keep for re-use. The Pressure Sensor cable will come out of the conduit.
  8. Loosen the clamp screw and remove the Pressure Sensor from the piping.

**CAUTION: Use the nut on the bottom of the Pressure Sensor during removal.**

9. Loosen and remove the bushing from the top of the Pressure Sensor. Keep for re-use.



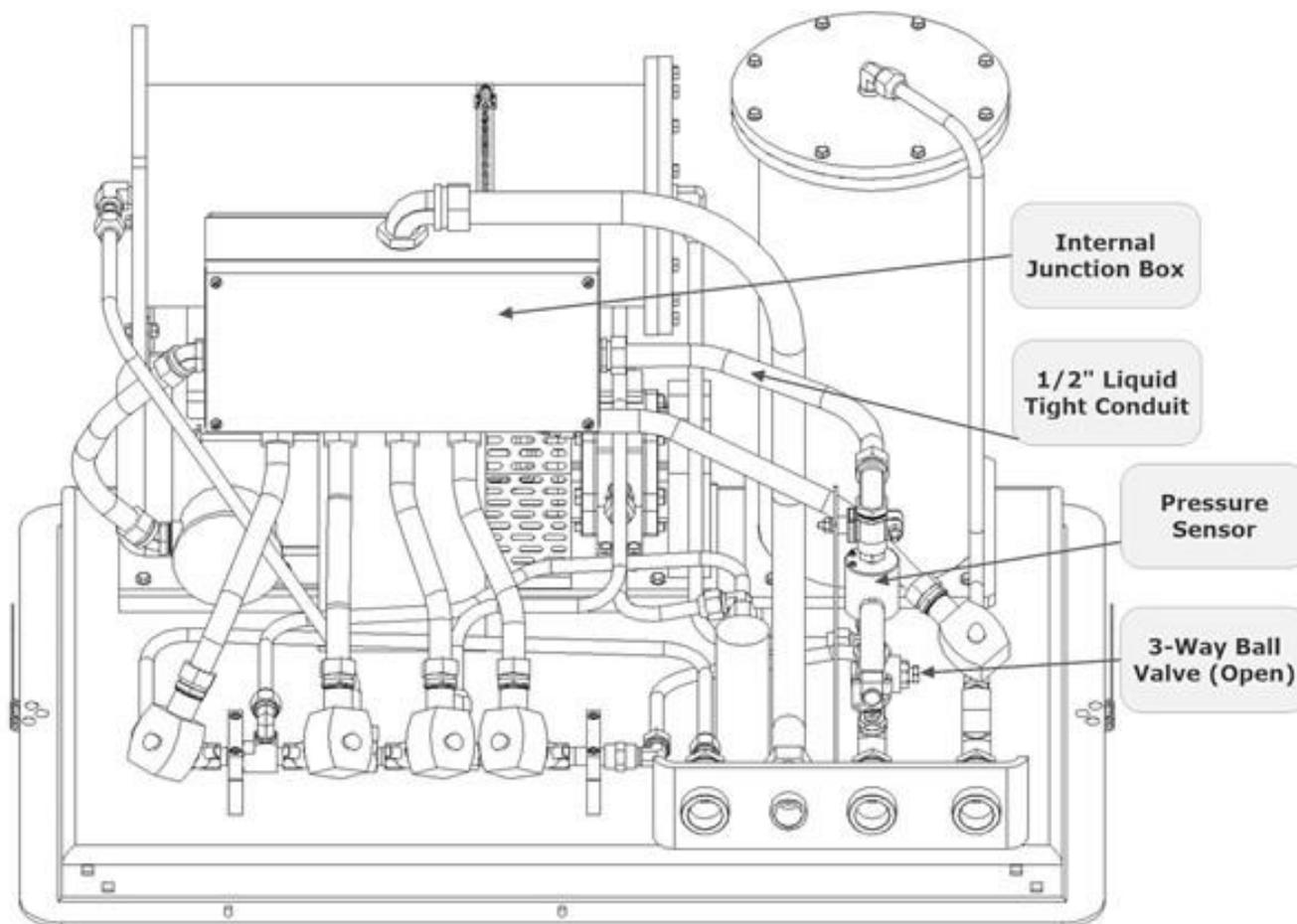
## 9.4.2 Installing the Pressure Sensor

- **See Figure 9-10.**

1. Install and tighten the bushing on the top of the Pressure Sensor.
2. Install the new Pressure Sensor. Use gasoline resistant PTFE tape on the pipe threads.

**CAUTION: Be sure to tighten the Pressure Sensor using the nut on the bottom of the sensor during the installation.**

3. Install the screw and tighten the clamp screw on the bushing.
4. Place the Pressure Sensor cable inside the Liquidtight conduit then tighten the Liquidtight conduit on the Pressure Sensor bushing and the Internal Junction Box.
5. Connect the Pressure Sensor wires to the terminal blocks inside the Internal Junction Box. **See Figure 9-11.**
6. Install the Internal Junction Box cover.
7. Remove the lock(s) and tags from the lockout & tagout.
8. Turn the Maintenance Switch OFF at the VST Control Panel so the GREEN MACHINE cannot operate.
9. Turn power ON to the VST Control Panel.
10. Verify Pressure Sensor Alarm is not active and the pressure reading on the PLC is approximately zero IWC.
11. Open the 3-way ball valve below the Pressure Sensor. (The handle is vertical.)
12. Put the cover on the GREEN MACHINE and lock the hasps.
13. Turn the Maintenance Switch ON so the GREEN MACHINE will operate when turned ON.
14. The GREEN MACHINE is now operational.



Green Machine Dual Canister Pressure Sensor Replacement, 09-23-2019

Figure 9-10: Pressure Sensor Replacement

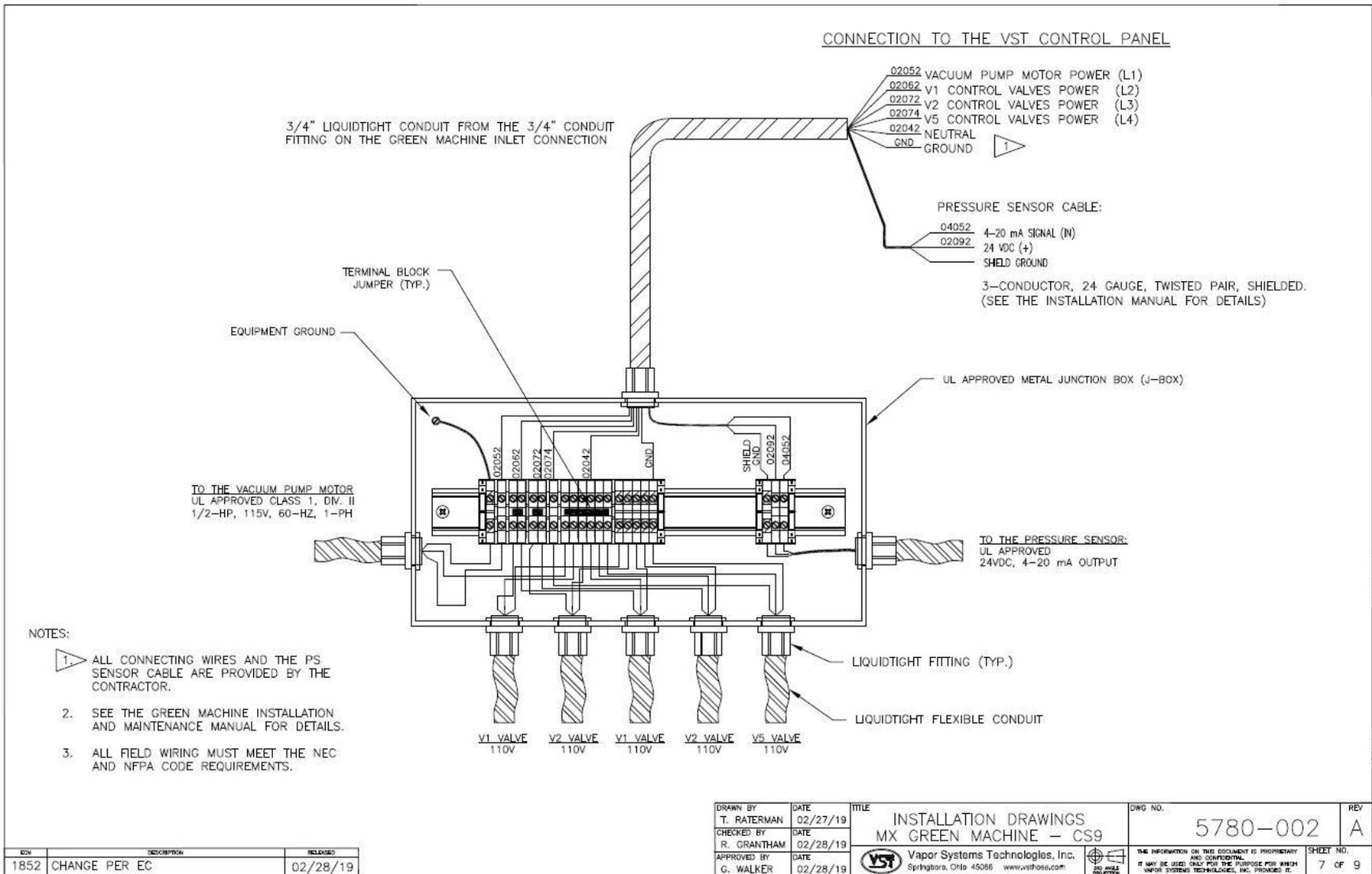


Figure 9-11: Wiring the Pressure Sensor Inside the Internal Junction Box



## 9.5 Rubber Flange Sleeve Replacement

### NOTE:

The Rubber Flange Sleeve replacement is done with the motor still attached to the GREEN MACHINE base.

### Safety



Use lockout / tagout procedures prior to starting work.

VST recommends replacing the Rubber Flange Sleeve every time Maintenance is performed on the GREEN MACHINE even if the Rubber Flange Sleeve does not look damaged or worn.

### 9.5.1 Removing the Rubber Flange Sleeve

See Figure 9-12.

1. Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel. (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE).
2. Follow lockout & tagout procedures prior to starting work.
3. Unlock the hasps and remove the cover from the GREEN MACHINE.  
NOTE: The Vacuum Pump and Vacuum Pump tubing will not be affected by moving the Vacuum Pump motor.
4. Remove the fan guard over the drive coupling flanges.
5.
  - Carefully move the junction box stand out of the way to allow for easier access to motor mounting bolts.
  - Remove the two bolts holding the Internal Junction Box stand to the GREEN MACHINE base. Keep the bolts for reuse.
6. Remove the 4 motor mounting bolts from the motor base plate. Keep the shims from under the motor base and 4-bolts for reuse.
7. Without removing the electrical service from the Vacuum Pump motor, slide the motor away from the Vacuum Pump so the rubber flange sleeve can be removed.

See Figure 9-13.

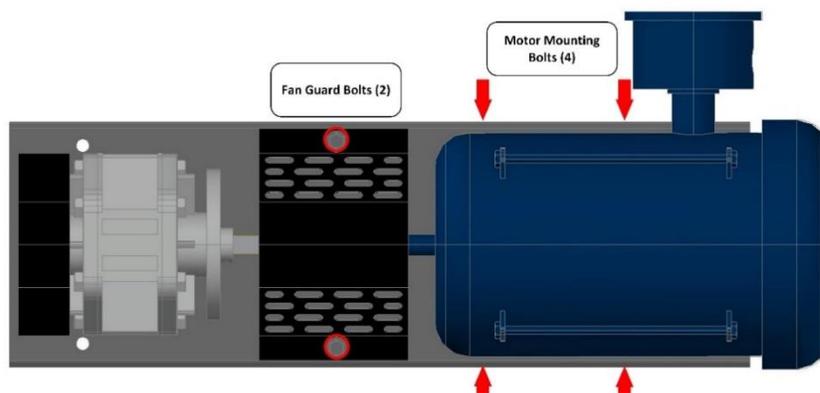


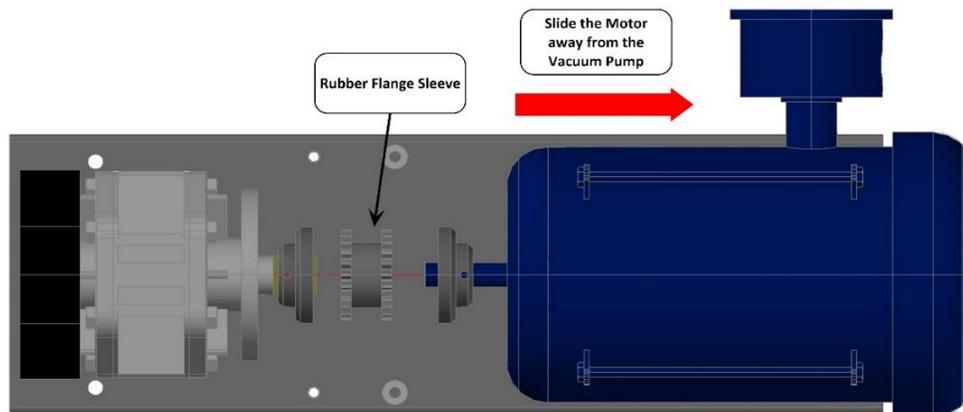
Figure 9-12: Vac Pump Rubber Flange Sleeve Replacement



## 9.5.2 Replacing the Rubber Flange Sleeve

See Figure 9-13.

1. Insert a new rubber flange sleeve and slide the motor back to its original position.
  - Make sure the motor-side drive coupling is snug (not tight) against the rubber flange sleeve.
2. Replace any shims that moved while moving the motor.
3. Re-install and tighten the 4 motor mounting bolts to the base plate. Make sure the Motor Shaft and Vacuum Pump shafts are in alignment.
4. Re-install the 2-bolts holding the Internal Junction Box stand to the GREEN MACHINE base.
5. Re-install the fan guard over the coupling flanges.
6. Put the cover on the GREEN MACHINE and lock the hasps.
7. Remove the lock(s) and tags from the lockout & tagout.
8. After the work is completed, turn ON power to the VST Control Panel. The GREEN MACHINE is now operational.



Vacuum Pump Rubber Flange Sleeve Replacement- A1

Figure 9-13: Replacing the Rubber Flange Sleeve



## 9.6 Vacuum Pump Motor (Only) Replacement

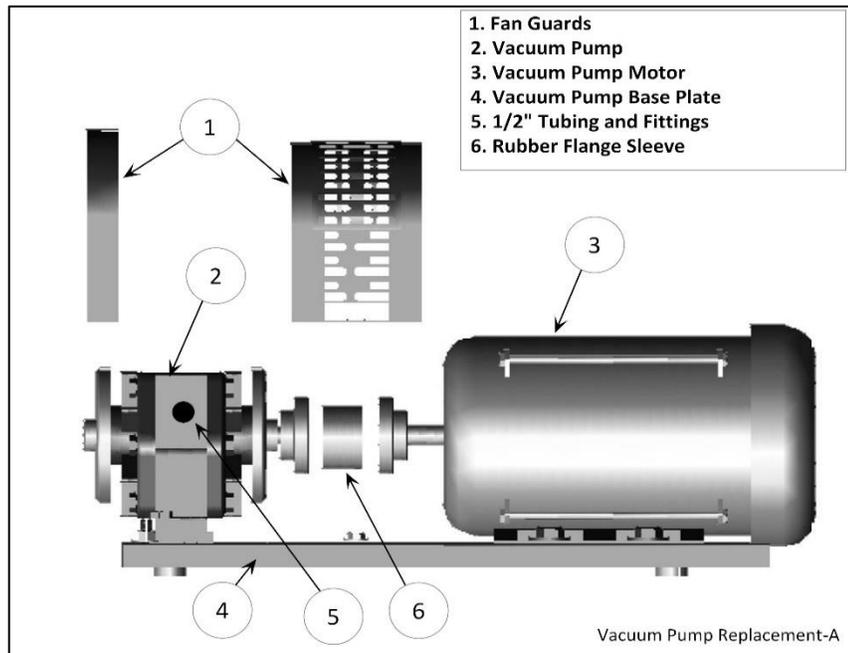


Figure 9-14: Vacuum Pump Components

### 9.6.1 Removing the Vacuum Pump Motor

- See Figures 9-14 & 9-15.
  1. Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel. (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE).
  2. Follow lockout & tagout procedures prior to starting work.
  3. Unlock the hasps and remove the cover from the GREEN MACHINE.  
**NOTE:** The Vacuum Pump and tubing will not be affected by removing the motor.
  4. Remove the fan guard over the drive coupling flanges.
  5. Disconnect the motor wires inside the motor junction box. See Figure 9-15.
  6. Remove the flexible conduit and 90° liquid tight fitting from the Vacuum Pump motor junction box and keep for re-use.
  7. Remove the two bolts holding the Internal Junction Box stand to the GREEN MACHINE base. Keep the bolts for re-use.
  8. Remove the 4 Vacuum Pump motor mounting bolts from the motor base and keep them for re-use.
    - Note the location of the shims for replacement.
  9. Slide the Vacuum Pump motor away from the Vacuum Pump and remove.
  10. The rubber flange sleeve between the Vacuum Pump and the motor may, at the discretion of the contractor, be replaced if worn.



## Removing the Vacuum Pump Motor, continued

11. Remove the Vacuum Pump motor drive coupling flange from the motor shaft and keep for re-use. The coupling is attached to the shaft with a setscrew and has a shaft key.

### 9.6.2 Replacing the Vacuum Pump Motor

- **See Figures 9-14 & 9-15.**

1. Re-install the drive coupling flange on the motor shaft but do not tighten the set screw and do not install the shaft key.
2. Place the new Vacuum Pump motor on the base, install the rubber flange sleeve between the two coupling flanges, and align the mounting holes.  
Replace the shims.
3. Re-install the 2-bolts holding the Internal Junction Box stand to the GREEN MACHINE base.
4. Re-install and tighten the 4 Vacuum Pump motor mounting bolts.
5. Slide the drive coupling flange over the rubber insert so both halves of the coupling are snug (not tight) against the rubber flange sleeve.
6. Install the shaft key, and tighten the set screw.
7. Install the 90° liquid tight fitting and flexible conduit on the motor junction box.
8. Re-connect the Vacuum Pump motor wires inside the motor junction box.  
**See Figure 9-15.**
9. Re-install the fan guard.
10. Remove the lock(s) and tags from the lockout & tagout.
11. Turn ON power to the VST Control Panel. At the VST Control Panel, put the PLC in the Maintenance Screen. At the Main Screen, push the Maintenance Screen button to access the Password Screen then enter the password to access the Maintenance Screen: Password is 878.
12. Perform a Bump Test to make sure the Vacuum Pump motor is rotating in the correct direction.  
(The Bump Test is located in Chapter 6: Start-Up & Testing.)
13. After the Bump Test is completed, push the ESC button so the Main Screen is showing at the PLC.
14. At the GREEN MACHINE, check to make sure the Vacuum Pump and Vacuum Pump motor are running without excessive vibration or noise. Excessive vibration or noise would indicate the motor, Vacuum Pump, or rubber flange sleeve may not be installed correctly.
15. Put the cover on the GREEN MACHINE and lock the hasps.

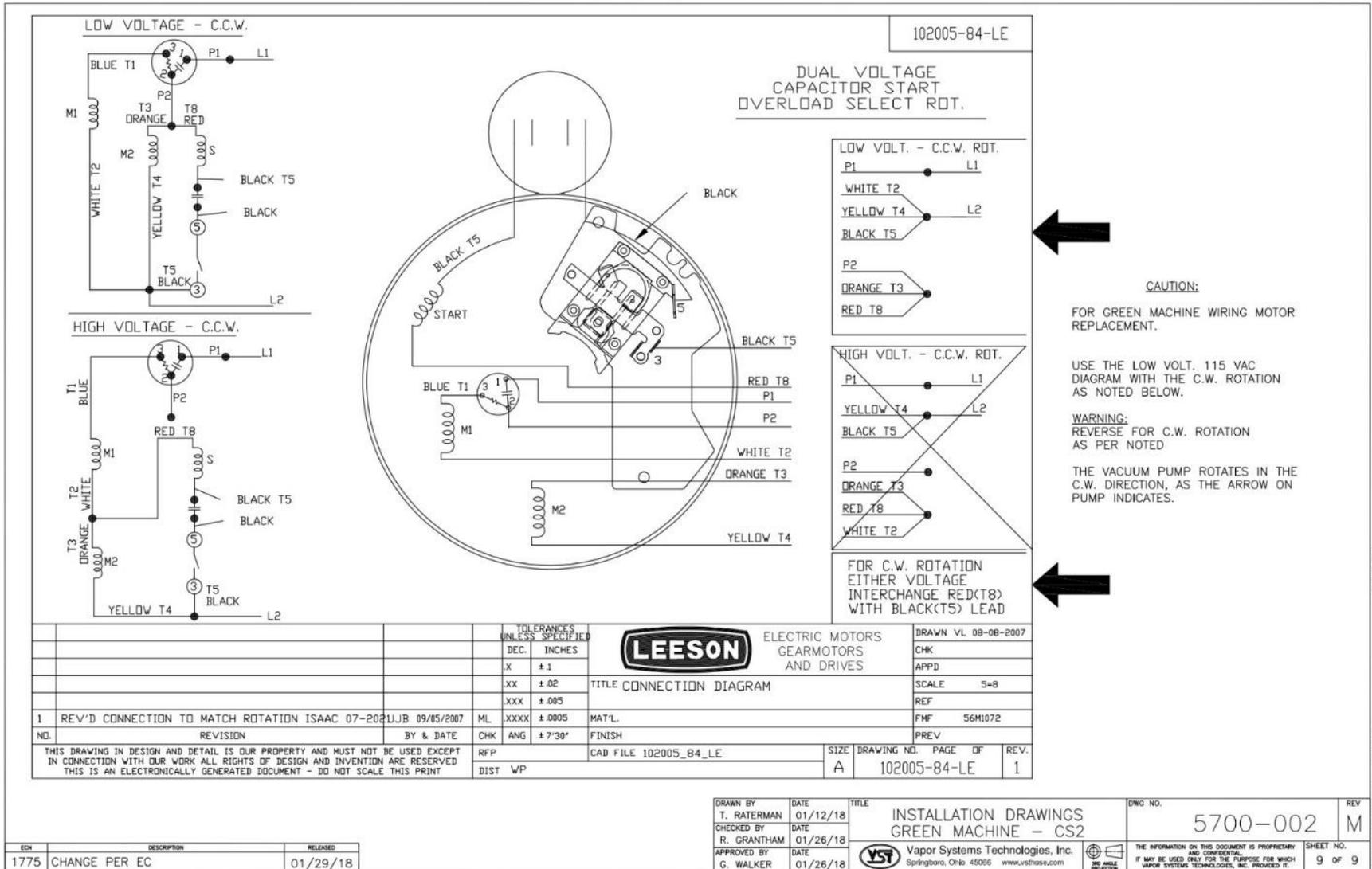
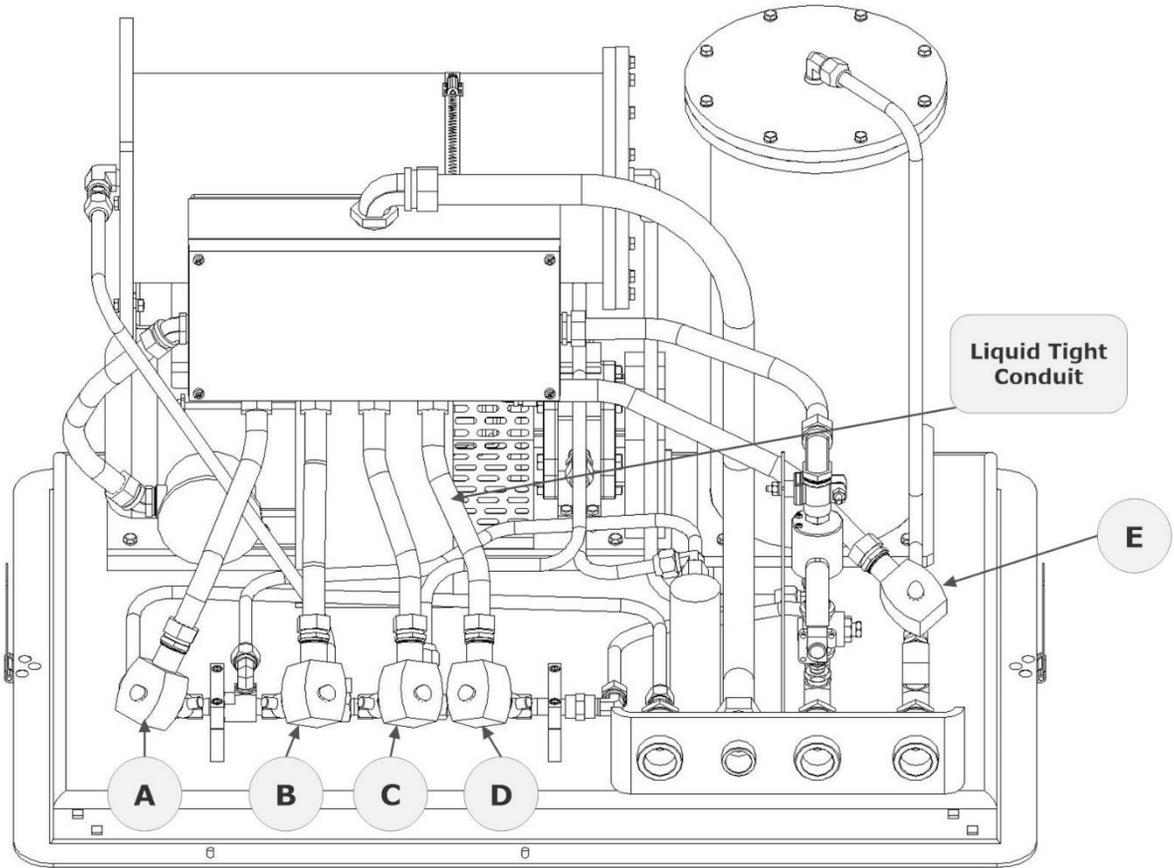


Figure 9-15: Junction Box Motor Wiring Diagram



## 9.7 Control Valve Replacement



GM Dual Canister Control Valve Replacement Diagram, 09-20-2019

Figure 9-16: Control Valve Replacement Diagram



### 9.7.1 Removing the Valve Solenoid and Core Assembly

See Figures 9-16 & 9-17.

1. Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel. (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE).
2. Follow lockout & tagout procedures prior to starting work.
3. Unlock the hasps and remove the cover from the GREEN MACHINE.
4. Unlock and close the three ball valves between the GREEN MACHINE and the vent risers.

**NOTE:** The Liquid Tight conduit or fitting do not have to be removed from the solenoid. See Figure 9-16.

5. Remove the red cap from the solenoid that is not working.
6. Remove the nameplate by pushing the solenoid down towards the valve body, then lift and slide the nameplate off.
7. Slide the solenoid off the solenoid base. DO NOT lose the spring washer located below the solenoid on the solenoid base.
8. Using a  $\frac{3}{4}$ " wrench, remove the solenoid base from the valve body, the core assembly with core spring, and the body gasket. Discard the used components.

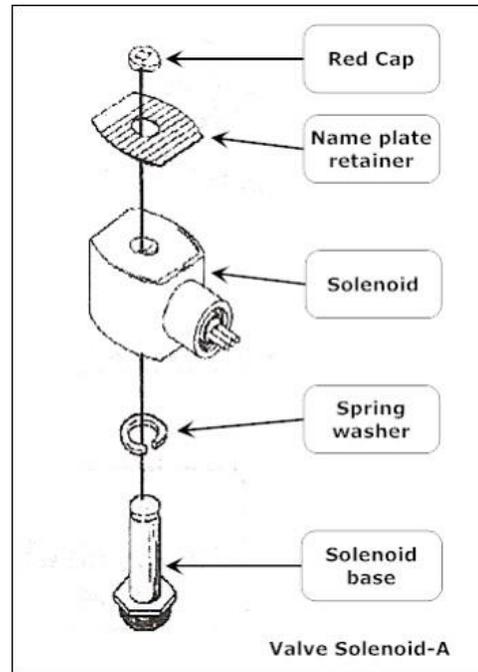


Figure 9-17: Valve Solenoid Assembly



## 9.7.2 Replacing the Valve Solenoid and Core Assembly

### See Figure 9-20.

1. Install a new Core Assembly which includes:
  - Solenoid base
  - Core assembly with core spring
  - Body gasket
2. Screw the solenoid base and tighten with a  $\frac{3}{4}$ " wrench until tight. Make sure to install the body gasket with the solenoid base.
3. Place the spring washer on the solenoid base, then slide the solenoid on to the solenoid base.
4. Slide and lock the nameplate on the solenoid.
5. Snap the red cap on the solenoid base.
6. Open the three ball valves between the GREEN MACHINE and the vent risers and lock in the OPEN position.
7. **CAUTION: THREE BALL VALVES BETWEEN THE GREEN MACHINE AND THE VENT RISERS MUST BE OPEN BEFORE APPLYING POWER TO THE VST CONTROL PANEL TO AVOID DAMAGE TO THE GREEN MACHINE INTERNAL EQUIPMENT.**
8. Put the cover on the GREEN MACHINE and lock the hasps.
9. Remove the lock(s) and tags from the lockout & tagout.
10. After the work is completed, turn ON power to the VST Control Panel. The GREEN MACHINE is now operational.

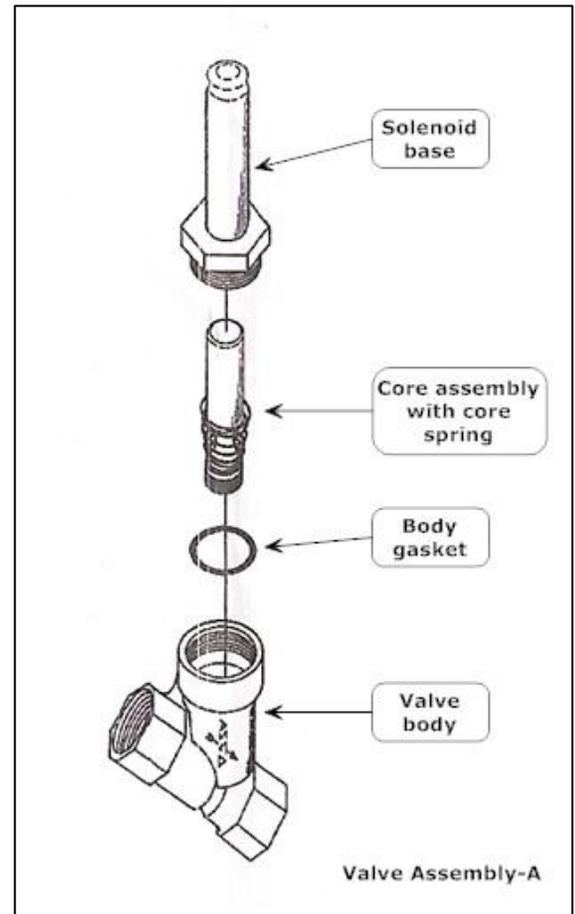


Figure 9-18: Valve Assembly



## 9.8 Vacuum Pump (Only) Replacement

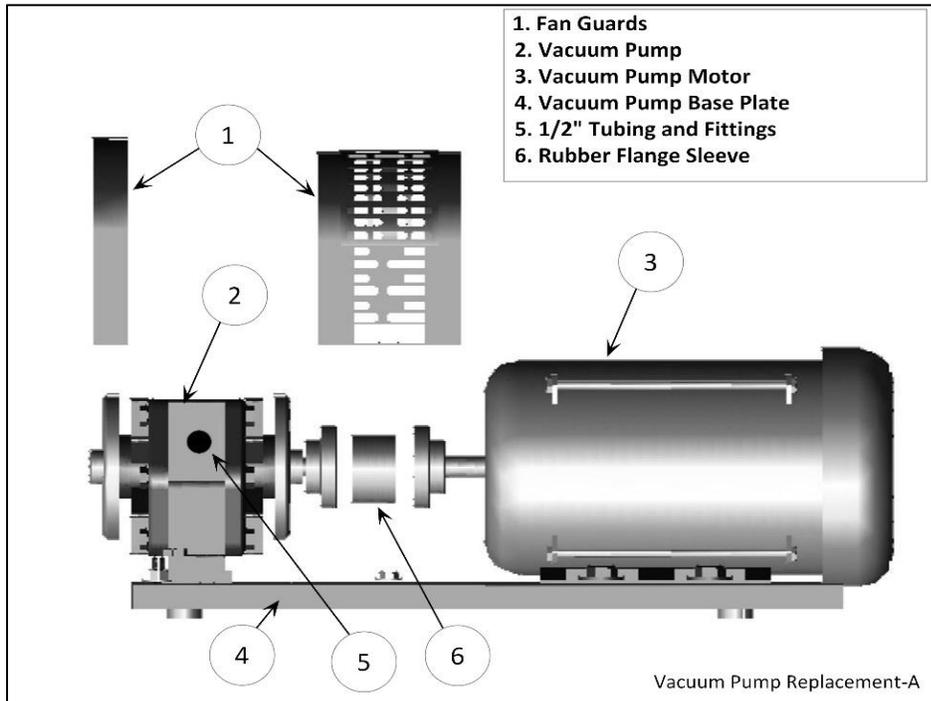


Figure 9-19: Vacuum Pump Components

### 9.8.1 Preparation for Cleaning the Tubes and Manifold

1. Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel. (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE).
2. Use Lockout/Tagout Procedures prior to starting work.
3. Unlock and close the 3 isolation valves between the GREEN MACHINE and the vent risers.
4. Unlock the hasps and remove the cover from the GREEN MACHINE.
5. Remove tubes 1, 2, 3, 4, 5, and 6 from the GREEN MACHINE. **See Figures 9-20 & 9-21.**

**CAUTION:** The tube ends are a Parker 45° flare, use caution not to damage the flared ends on the tubing or the threads on the nuts after removal.

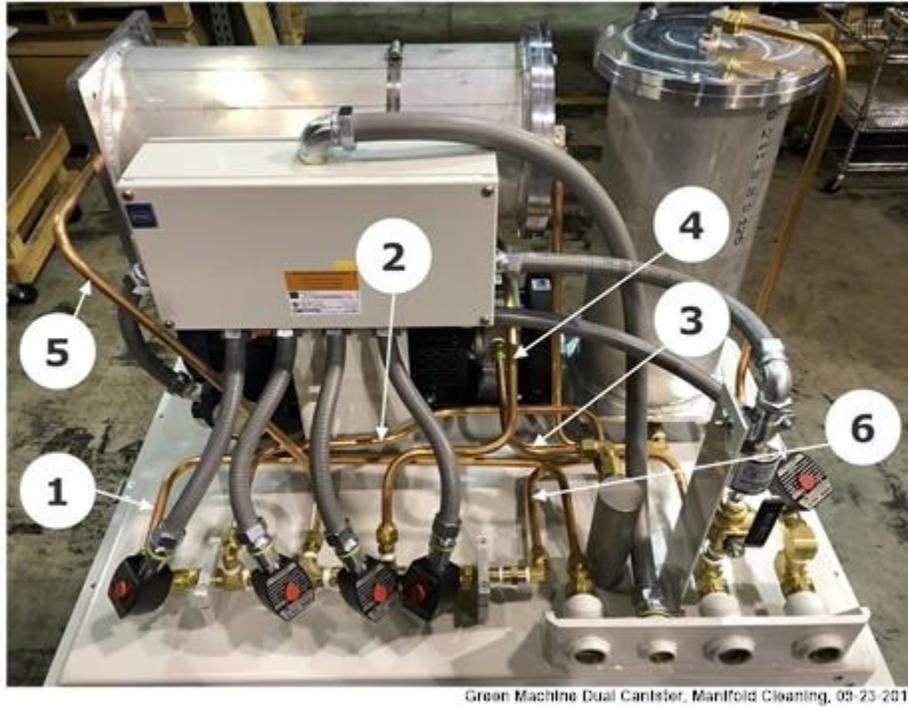


Figure 9-20: Items Associated with Cleaning the GREEN MACHINE Tubing and Manifold

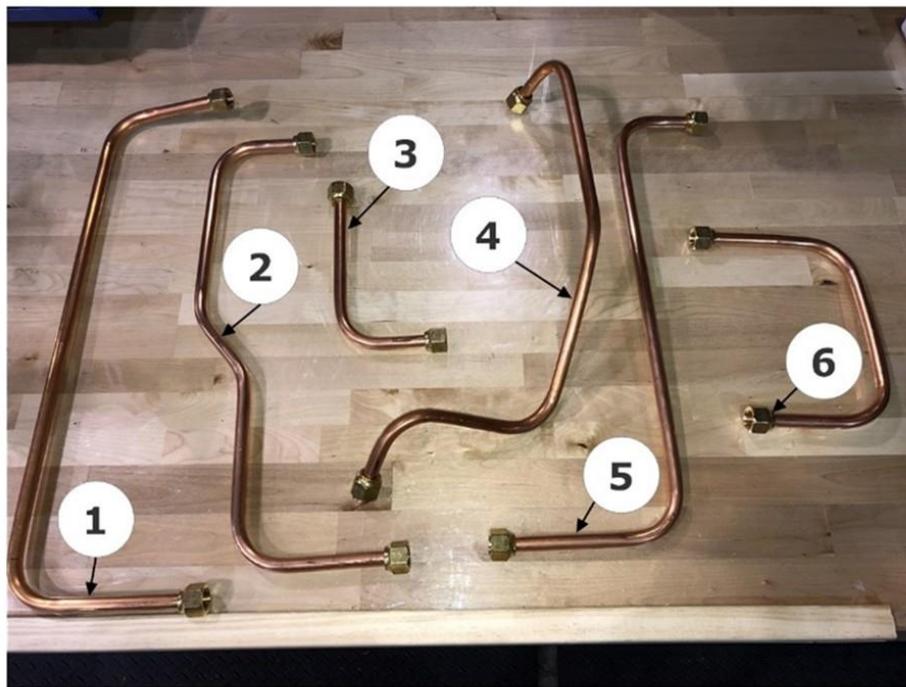


Figure 9-21: Tubes 1-6 Removed



### 9.8.2 Removing the Vacuum Pump

1. For the Vacuum Pump Assembly and Components, **See Figure 9-22.**
2. Make sure the power is OFF to the VST Control Panel at the Power Switch located on the front of the VST Control Panel.

NOTE: The Motor will not be affected during the replacement of the Vacuum Pump.

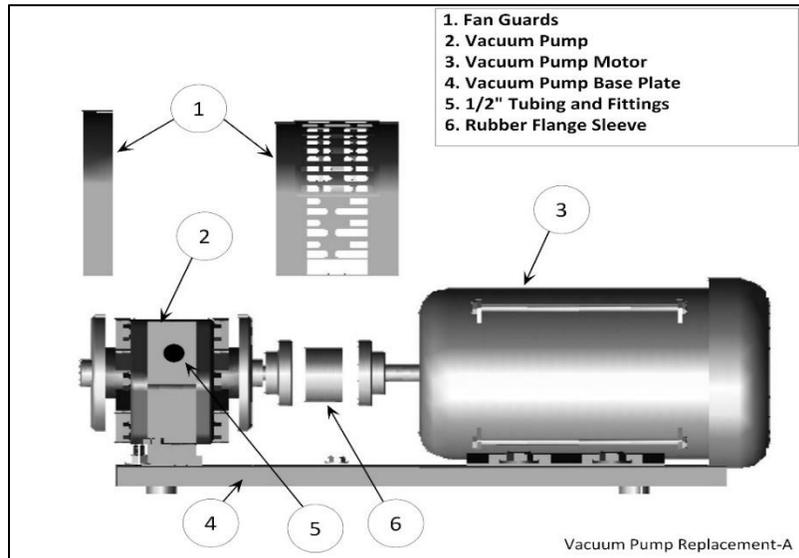


Figure 9-22: Vacuum Pump Assembly and Components

3. Remove the brass pipe fittings from both sides of the Vacuum Pump and keep for reuse.

**CAUTION:** The fittings are a Parker 45° flare, use caution not to damage the 45° flare fittings or the threads after removal.

4. Remove the fan guard (the large center guard #1 in **Figure 9-22**) for access to the coupling flanges and removal of the Vacuum Pump.
5. Loosen the drive coupling set screws on the motor side of the rubber flange sleeve, then slide the drive coupling towards the motor. Penetrating oil may be needed to slide the flange sleeve.  
Remove the rubber flange sleeve and discard.
6. The rubber flange sleeve between the Vacuum Pump and the motor must be replaced with each new pump.
7. Remove the 4 mounting bolts from the Vacuum Pump base and keep for re-use.

**CAUTION:** There may be metal shims under the Vacuum Pump. They must be marked for location and saved for re-use.

8. Slide the Vacuum Pump towards the motor and remove.



### 9.8.3 Replacing the Vacuum Pump

1. The new pump will come with a drive coupling and rubber flange sleeve.  
**See Figure 9-22.**  
Install the flange coupling on to the pump shaft. Then install the rubber flange sleeve
2. into the pump flange coupling so that when the pump is installed, the rubber flange sleeve mates with the motor flange coupling.
3. Place the new Vacuum Pump on the base and align the mounting holes.  
Remember to re-install the shims under the Vacuum Pump.
4. Reinstall and tighten the 4-Vacuum Pump mounting bolts so the pump shaft aligns with the motor shaft.  
Slide the drive-coupling flange over the rubber flange sleeve so both halves of the
5. coupling are snug (not tight) against the rubber flange sleeve and tighten the set screws.  
Double check to make sure both coupling set screws are tight.  
Wrap the pipe fitting threads with gasoline resistant PTFE tape a maximum of three
6. revolutions and reinstall the pipe fittings. The 90° fitting must be installed on the back of the Vacuum Pump, and the straight fitting must be installed on the front.  
**CAUTION:** Do not use any thread sealing compound when assembling the 45° flare nuts.  
**CAUTION:** When tightening the 45° flare nuts: Clamp the tube flare between nut and nose body of the tube by screwing the nut on finger tight. Tighten with a wrench an additional ¼ turn for a metal-to-metal seal.
7. Re-install the fan guard.



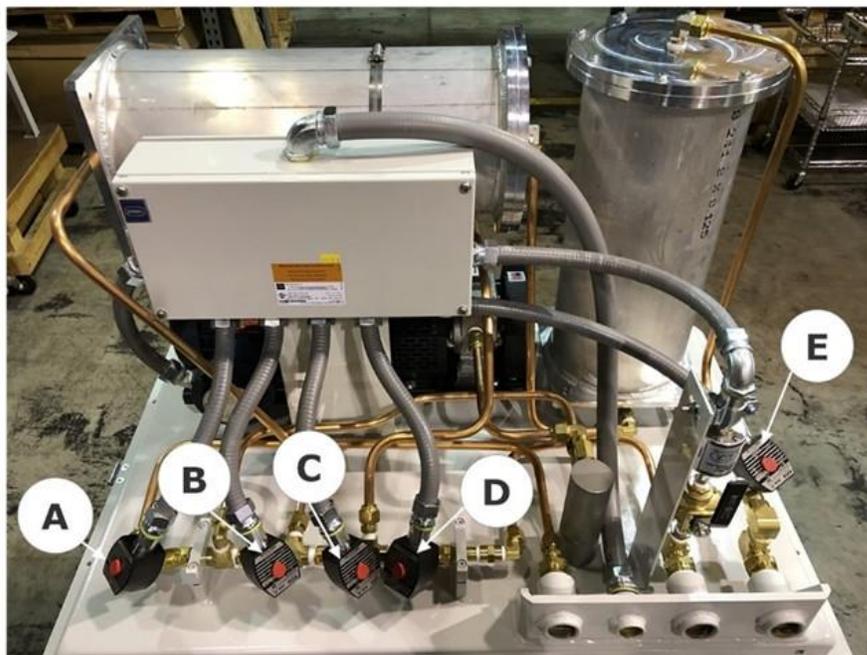
#### 9.8.4 Preparation for Cleaning the Tubes and Manifold

1. On the manifold, remove the Solenoids A, B, C, and D from the 4 Control Valves located on the manifold. Do not remove Solenoid E. **See Figure 9-23.**
2. GM Control Valve Assembly and Components. **See Figure 9-24.**
3. Remove the RED Cap from the Solenoid Base and the Nameplate/Retainer and keep for reuse. **See Figure 9-25.**
4. Slide the Solenoid off the Solenoid Base. Do not remove the flexible conduit from the Solenoid.
5. Remove the Spring Washer from the Solenoid Base and keep for reuse.
6. Use a 1" wrench to remove the Solenoid Base from the Valve Body. Keep the Solenoid Base, the Core Assembly and Body Gasket for reuse. **See Figures 9-26.**
7. Place the empty Solenoid Base inside the Solenoid, then attach the RED Cap. Do this for all four Solenoids. **See Figures 9-27 and 9-28.**

**WARNING:** The Solenoid Base MUST BE INSTALLED inside the Solenoid so the magnetic field around the Solenoid will not breakdown when power is applied to the Solenoid.

8. Move the four Solenoids out of the way of the manifold. **See Figure 9-29.**
9. The Manifold is now ready to clean. **See Figure 9-30.**
10. Install the provided Blowout Tube with the clear plastic tubing attached to the discharge side of the Vacuum Pump. Tighten the 45° nut on the fitting hand tight. **See Figure 9-31.**

**CAUTION:** Do not use any thread sealing compound when assembling the 45° flare nuts on the tubes



Green Machine Dual Canister Manifold Valves, 09-23-2019

Figure 9-23: Manifold Valves



Figure 9-24: GM Control Valve Assembly and Components

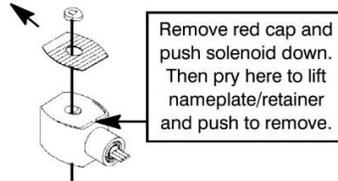


Figure 9-25: How to remove the Red Cap from the Solenoid Base

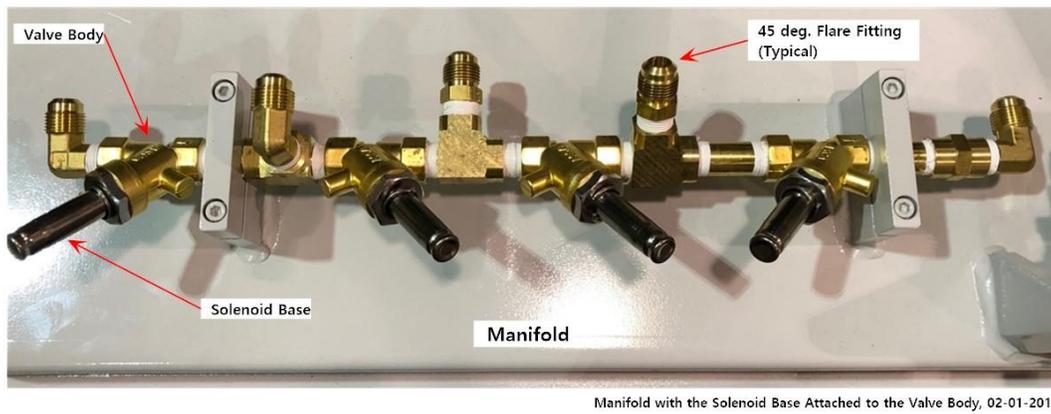


Figure 9-26: Manifold with the Solenoids Removed, showing the Solenoid Bases



Figure 9-27: Solenoid with Solenoid Base and RED Cap

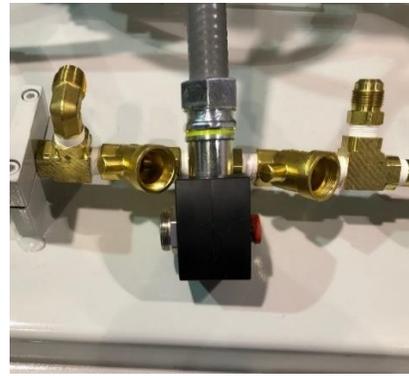
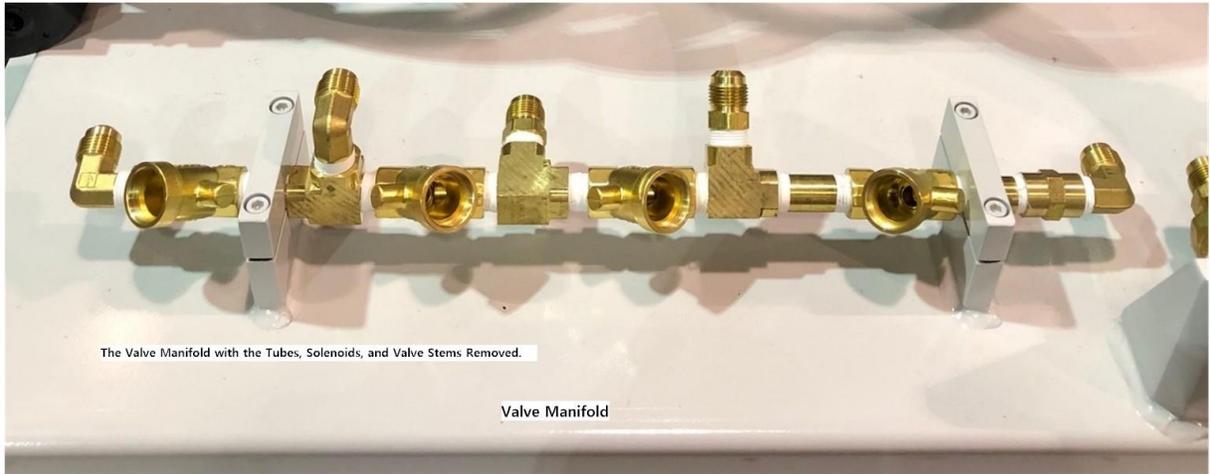


Figure 9-28: Solenoid with the Solenoid Base and RED Cap Installed

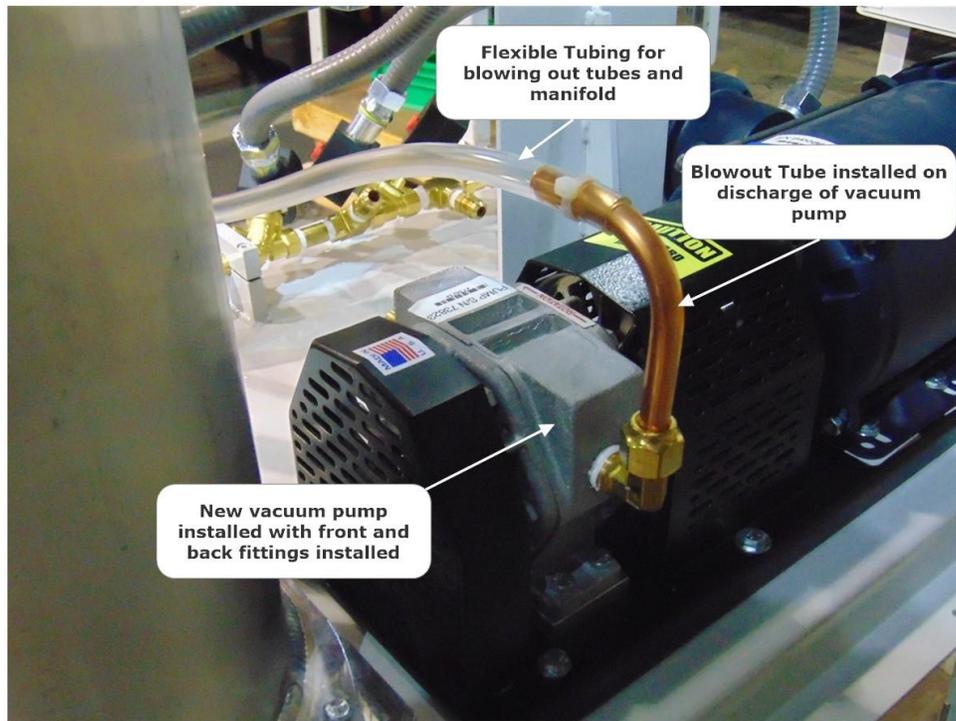


Figure 9-29: Solenoids (with the Solenoid Bases Installed) Arranged Out of the Way



Valve Manifold with Everything Removed, 01/24/2019

Figure 9-30: Manifold Ready for Cleaning



Vacuum Pump with Fittings and Blowout Tube Installed, 3-20-2019

Figure 9-31: Vacuum Pump with the Blowout Tube Installed



### 9.8.5 Cleaning the Tubes and Manifold

1. At the VST Control Panel, remove the Lockout/Tagout lock(s).
2. Turn ON power to the VST Control Panel at the Power Switch.
3. Make sure the Maint. Switch is turned ON.
4. At the Main Screen, push the Maintenance Screen button to access the Password Screen, then enter the password to access the Maintenance Screen: Password is 878.

**See Figure 9-32.**

(The password is 123 on older models of the VST Control Panel.)

5. At the Maintenance Screen, push the grey Manual ON so the Vacuum Pump will operate. This will allow the Vacuum Pump to blow outside air through the plastic tube.

**WARNING:** Safety Glasses MUST BE USED when blowing out the Tubes and Manifold.

6. Using the plastic tube, blow air through the 6 removed copper tubes to remove any potential debris. **See Figure 9-31.**
7. Using the plastic tube, blowout each of the openings in the manifold starting at right side, and progress to the other end. **See Figure 9-30.**
8. Then blowout each of the manifold openings again starting at the left side and progress to the other end.
9. The Cleaning of the tubes and manifold is complete.
10. At the VST Control Panel Maintenance Screen, push the Manual OFF button to turn OFF the Vacuum Pump.
11. At the VST Control Panel, turn the Maint. Switch to OFF.
12. At the GREEN MACHINE, remove the blowout fitting from the Vacuum Pump.

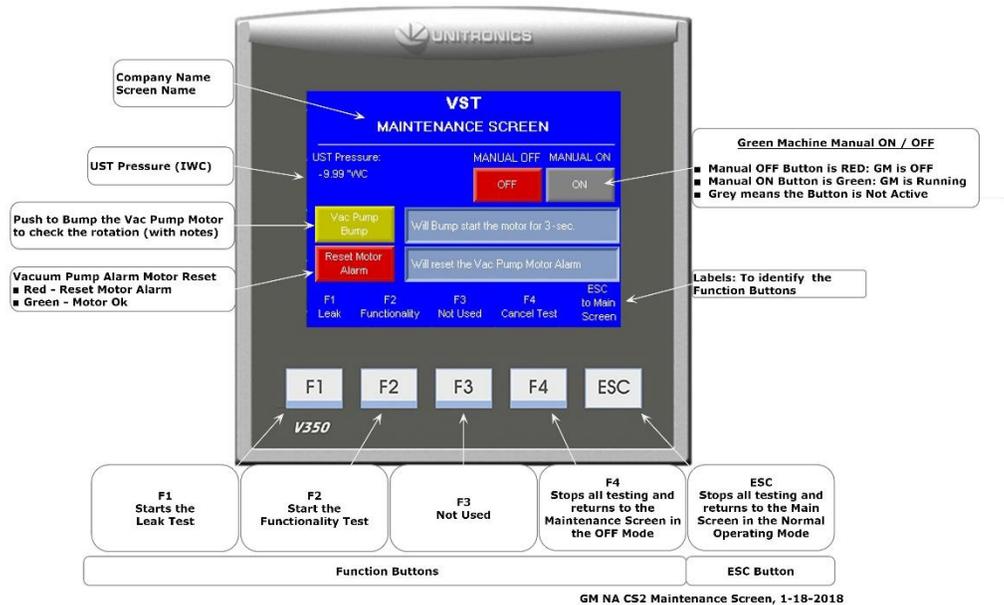


Figure 9-32: Maintenance Screen



### 9.8.6 Reassemble the Tubes and Valve Components

1. Remove the Solenoid Bases from the Solenoids. Save the Solenoid Bases and RED Caps for reuse.
2. Install the Body Gasket, Core Assembly, and Solenoid Base in the Valve Body. (Typical on all 4 Valve Bodies). **See Figure 9-24.**  
**CAUTION:** The Body Gaskets must be clean and apply fresh Petroleum Jelly lubricant.
3. Install the Solenoids on to the Solenoid Bases, then install the Nameplate/Retainers and RED Caps.
4. Reinstall the 6 tubes. **See Figures 9-20 and 9-21.**  
**CAUTION:** When tightening the 45° flare nuts: Clamp the tube flare between nut and nose body of the tube by screwing the nut on finger tight. Tighten with a wrench an additional ¼ turn for a metal-to-metal seal.

### 9.8.7 Conduct a Functionality Test

Conduct a Functionality Test as shown in Chapter 6 of this document.

### 9.8.8 Ending Stage

1. Lock open the three ball valves between the GREEN MACHINE and the Vent Risers and replace the caps on the three tees.
2. Open the 3-way valve below the Pressure Sensor so the handle is turned VERTICALLY (ON or OPEN).  
**CAUTION: Make sure the 3-way valve below the Pressure Sensor is turned VERTICAL (ON or Open). Leaving the valve turned OFF at the Pressure Sensor will not allow the GREEN MACHINE to operate in the Normal Operating Mode.**
3. Put the cover on the GREEN MACHINE and lock the hasps.
4. Remove the lock(s) and tags from the lockout & tagout.
5. After the work is completed, turn ON power to the VST Control Panel. Make sure the Main Screen is showing on the PLC.  
Make sure the Maint. Switch on the VST Control Panel is turned ON. (Or the GREEN MACHINE will not operate.)
6. The GREEN MACHINE is now operational.



## 9.9 Vapor Filtration Cartridge Assembly Replacement

### Safety



Use lockout / tagout procedures prior to starting work.

#### 9.9.1 Removing the 8" Vapor Filtration Cartridge Assembly (#1 and #2)

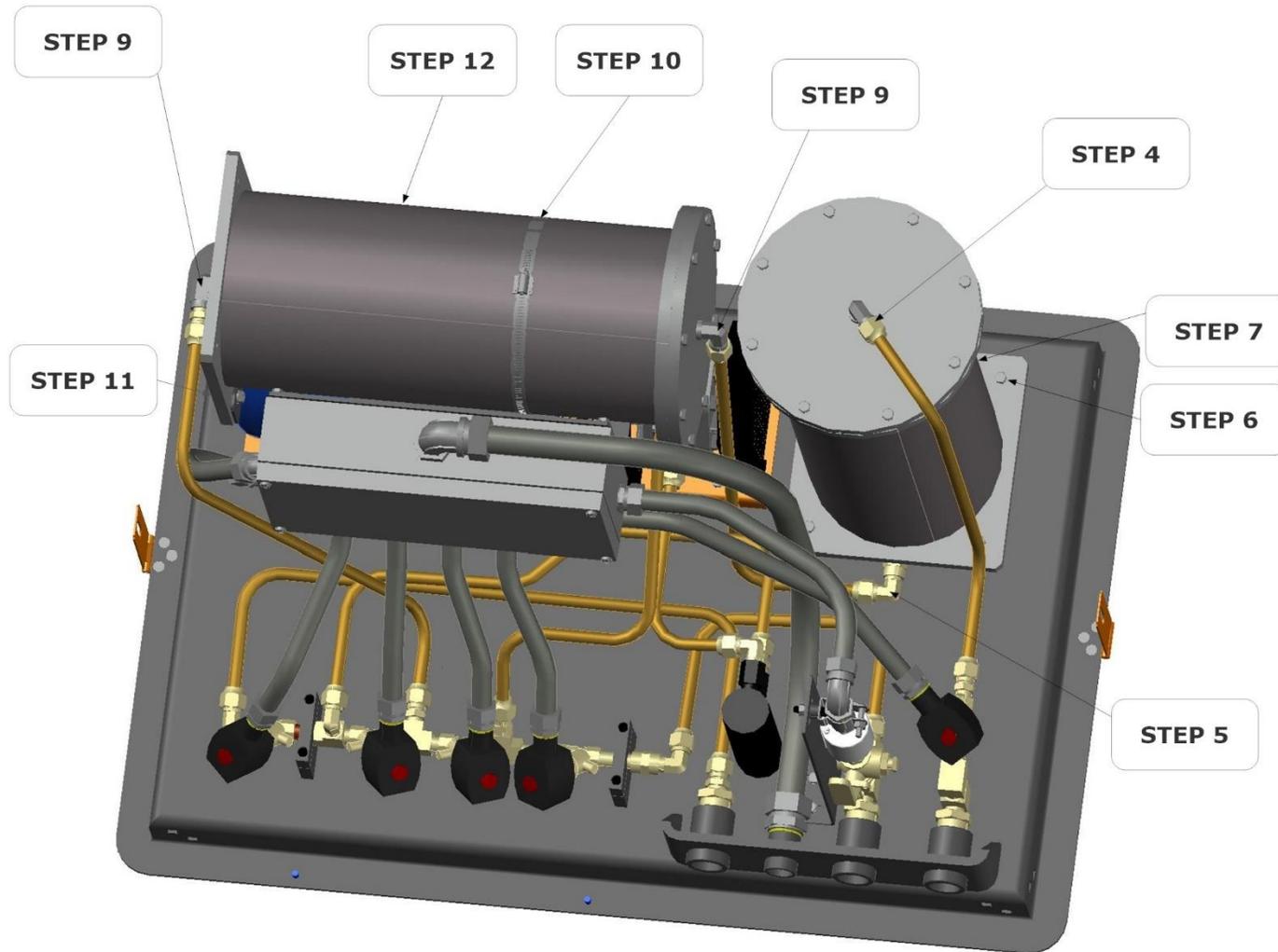
1. Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel. (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE).
2. Follow lockout & tagout procedures prior to starting work.
3. Unlock the hasps and remove the cover from the GREEN MACHINE.

##### **Removing Vapor Filtration Cartridge Assembly #1 - See Figure 9-33.**

4. Loosen the brass 45° flare nuts on the 90° elbow at the top of the cartridge.  
Do not remove the tubing.
5. Loosen the brass 45° flare nuts on the 90° elbow at the bottom of the cartridge.  
Do not remove the tubing.
6. Remove the 4-bolts holding the cartridge to the GREEN MACHINE base. Discard the bolts, lock washers, and aluminum risers.
7. Remove the cartridge from the GREEN MACHINE base.
8. Purge the removed cartridge with compressed air for 24 hours to remove any hydrocarbons (if any) before discarding.

##### **Removing Vapor Filtration Cartridge Assembly #2 – See Figure 9-33.**

9. Loosen the brass 45° flare nuts on the 90° elbows at the both ends of the cartridge.  
Do not remove the tubing.
10. Loosen the screw on the band clamp. Do not try to remove the band clamp from the support structure.
11. Loosen and remove the two hex bolts on the end of the cartridge. Keep for reuse.
12. Remove cartridge from the support structure.
13. Purge the removed cartridge with compressed air for 24 hours to remove any hydrocarbons (if any) before discarding.



**GM Replacing the Two Cartridges, 10/9/2019**

**Figure 9-33: Vapor Filtration Cartridge Assembly Replacement**



## 9.9.2 Installing the New 8" Vapor Filtration Cartridge Assembly (#1 and #2)

Both new 8" Vapor Filtration Cartridge Assemblies will arrive with all the tubing fittings attached. Vapor Filtration Cartridge Assembly #1 will arrive with new bolts, washers, and aluminum risers.

### Installing Vapor Filtration Cartridge Assembly #1

1. Install the 8" cartridge on the GM base with the new risers, bolts, and lock washer. Do not tighten the bolts at this time.

**CAUTION:** When installing the 45° flare nuts to the 90° elbow fitting, do not use any thread sealing compound when assembling the 45° flare nuts on the tubes.

**CAUTION:** When tightening the 45° flare nuts: Clamp the tube flare between nut and nose body of the tube by screwing the nut on finger tight. Tighten with a wrench an additional ¼ turn for a metal-to-metal seal.

2. Attach the tubing 45° flare nuts at the top of the cartridge to the 90° elbow.
3. Attach the tubing 45° flare nuts at the bottom of the cartridge to the 90° elbow.
4. With all the tubes installed and the flare nuts tightened, tighten the bolts holding the cartridge to the GREEN MACHINE base.

### Installing Vapor Filtration Cartridge Assembly #2

5. Place cartridge #2 on the saddles of the support base. Orient the cartridge as shown in **Figure 9-33** with the 90° elbow point forward on the left-hand side, and the 90° elbow pointing down on the right-hand side.
6. Put the band clamp around the cartridge and loosely tighten the screws so the cartridge can slide to the left or right.
7. Replace the nuts and bolts on the left side of the cartridge.
8. Slide the cartridge so the left brass 45° flare nut can be screwed to the 90° elbow. Then tighten the nut as indicated above.
9. Install the 45° flare nut on the 90° elbow on the right side of the cartridge. Then tighten the nut as indicated above.
10. Tighten the screw on the band clamp.

### Completing the Work:

11. Install the cover on the GREEN MACHINE and lock the hasps.
12. Remove the locks from lockout & tagout.
13. Turn ON power at the Power Switch on the front of the VST Control Panel. The GREEN MACHINE is now operational.



## 9.10 Separator Replacement

### 9.10.1 Safety

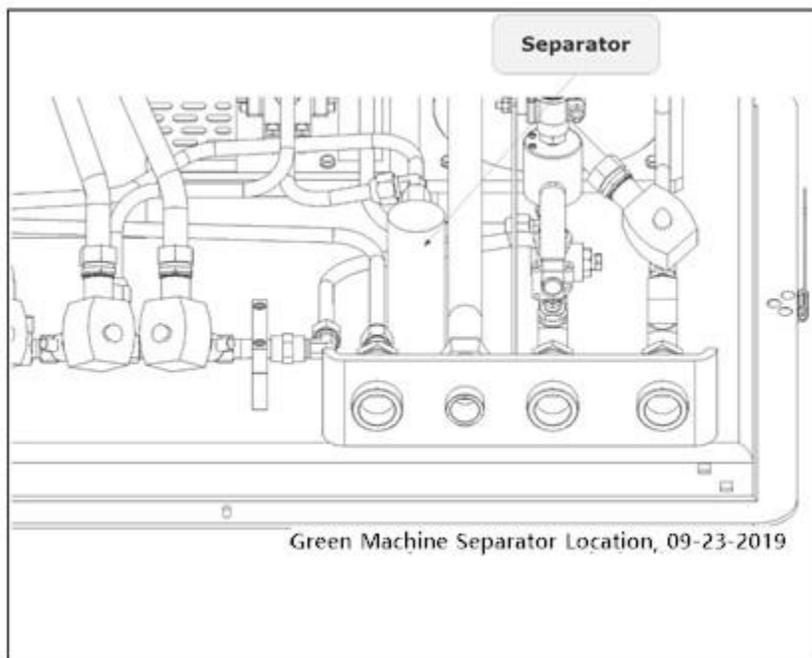


Use lockout / tagout procedures prior to starting work.

### 9.10.2 Removing and Inspecting the Separator

**See Figure 9-34.**

1. Turn OFF power to the VST Control Panel at the Power Switch located on the front of the VST Control Panel. (The power, ground, and neutral will be completely disconnected from the GREEN MACHINE).
2. Follow lockout-tagout procedures prior to starting work.
3. Unlock the hasps and remove the cover from the GREEN MACHINE.
4. Remove the two 45° flare tubing connections from the separator, being careful not to damage the copper tubing.
5. Remove the 90° and straight pipe fittings from the existing separator for reuse.
6. The existing separator can be discarded.



**Figure 9-34: Separator Location**



### 9.10.3 Installing a New Separator

See Figure 9-35.

1. Wrap the pipe fittings with gasoline resistant PTFE tape, and install the pipe fittings into the new separator.
2. Place the new separator into position in the GREEN MACHINE.
3. Re-install two 45° flare tubing connections.  
**CAUTION:** Do not use any thread sealing compound when assembling the 45° flare nuts.  
**CAUTION:** When tightening the 45° flare nuts: Clamp the tube flare between nut and nose body of the tube by screwing the nut on finger tight. Tighten with a wrench an additional ¼ turn for a metal-to-metal seal.
4. Put the cover on the GREEN MACHINE and lock the hasps.
5. Remove the lock(s) and tags from the lockout-tagout.
6. After the work is completed, turn ON power to the VST Control Panel. The GREEN MACHINE is now operational.

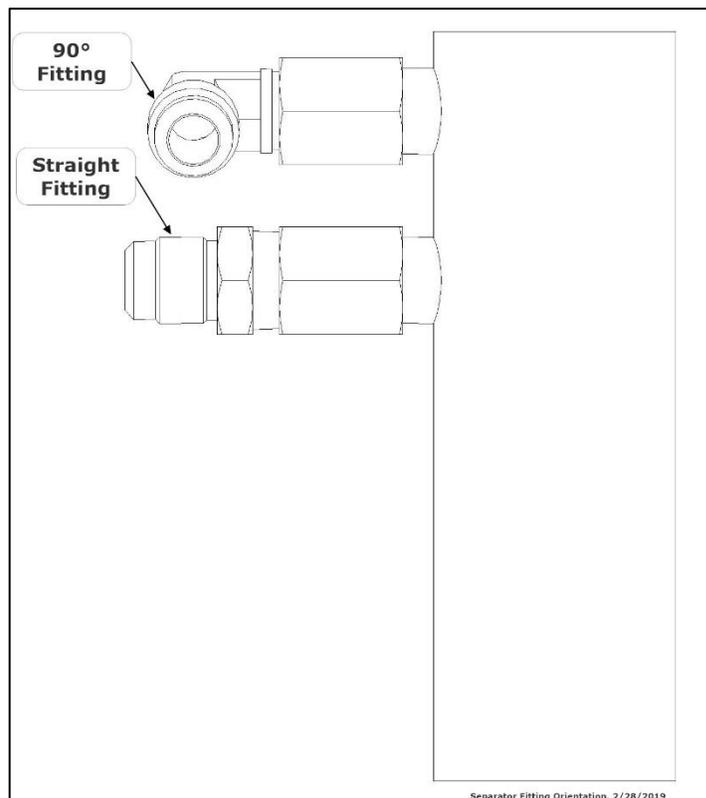


Figure 9-35: Separator Fitting Orientation



## 9.11 Leak Test

### 9.11.1 Purpose of the Leak Test

- The purpose of the Leak Test is to ensure that all of the GREEN MACHINE tubing fittings and tubes located inside the GREEN MACHINE are leak free.

### 9.11.2 Preparation for the Leak Test

1. At the GREEN MACHINE, remove the locks from the three ball valves, close the three valves, and remove a cap from one of the tees. (Only one open tee is required for this test.) **See Figure 9-36.**
2. CAUTION: Make sure the 3-way valve below the Pressure Sensor is turned HORIZONTAL (OFF or Closed). Leaving the valve ON during this test may damage the Pressure Sensor.
3. Make sure the Maintenance Screen is showing on the PLC. **See Figure 9-37.** (The GREEN MACHINE is now in the Manual OFF mode and will not operate.)

If the PLC is not in the Maintenance Screen: At the Main Screen, push the Maintenance Screen button to access the Password Screen, then enter the password to access the Maintenance Screen: 878.

4. Compressed Nitrogen bottle with a regulator is required for the Leak Test.
5. A Leak Test Fixture is required for the Leak Test. **See Figure 9-40.**

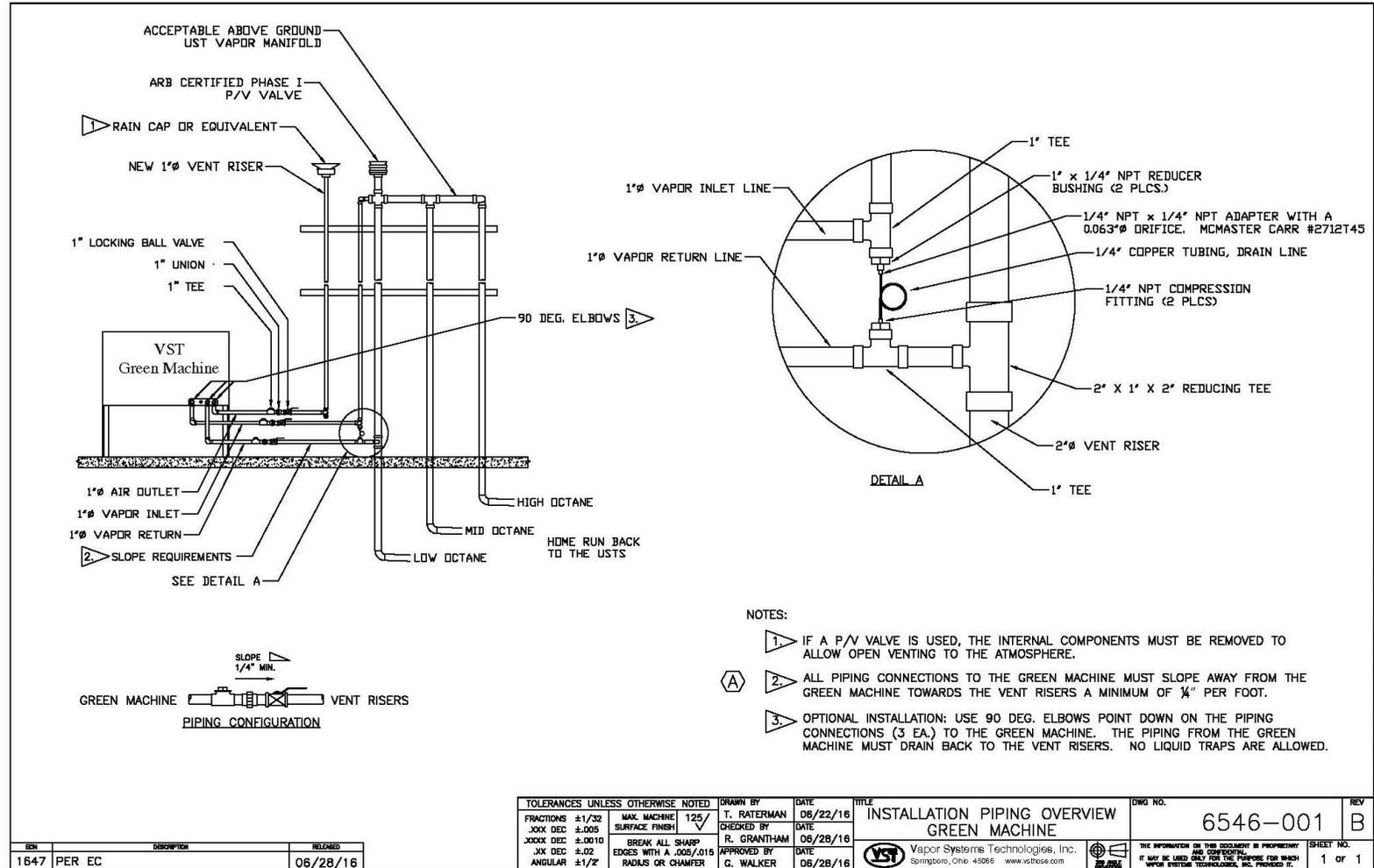
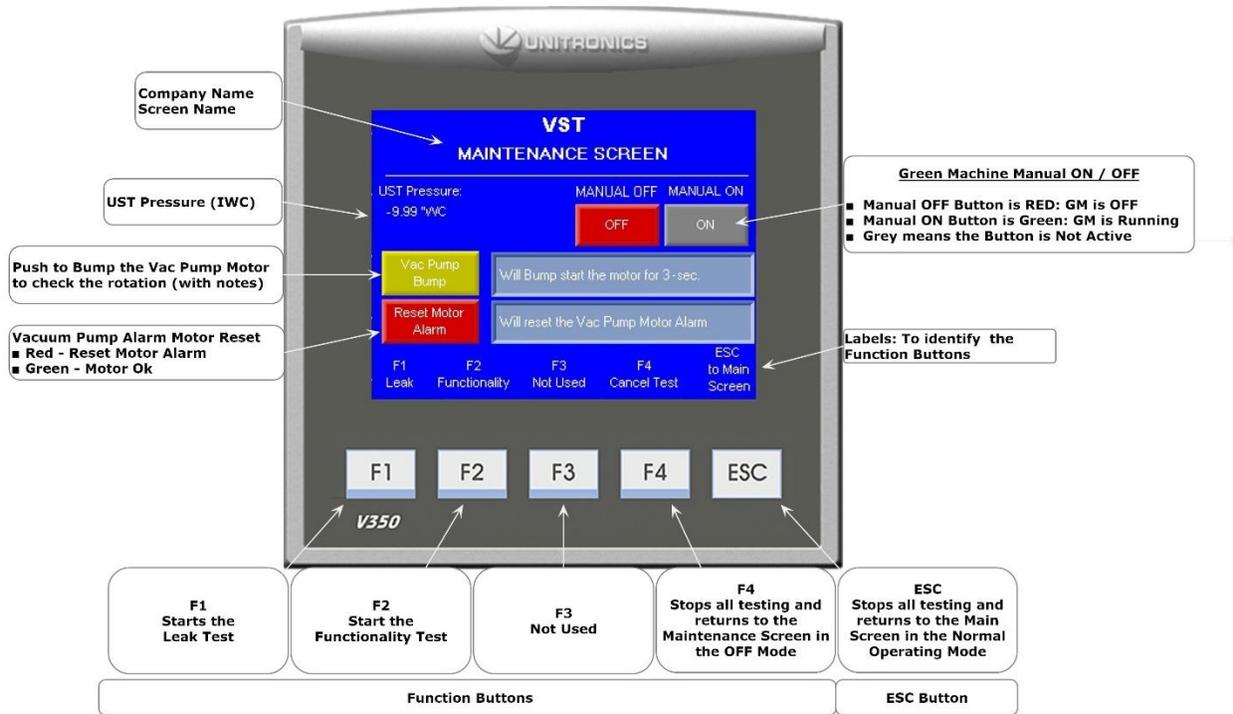


Figure 9-36: Vapor Piping Overview



GM NA CS2 Maintenance Screen, 1-18-2018

Figure 9-37: Maintenance Screen

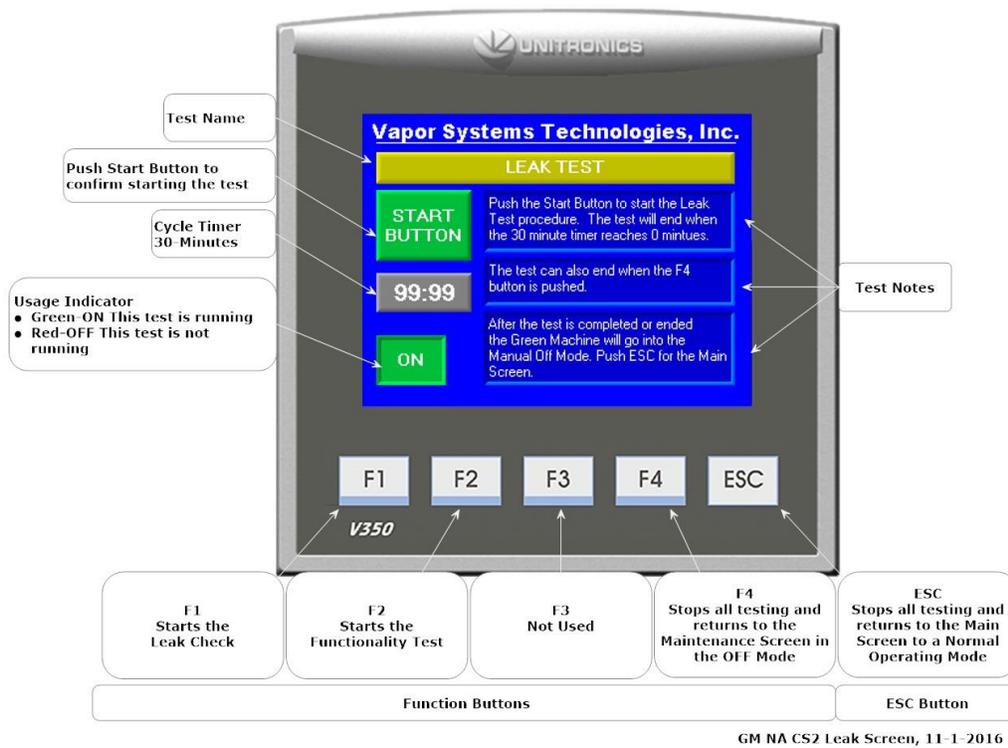


Figure 9-38: Leak Test Screen



Leak Test Procedure, continued...

### 9.11.3 Leak Test Procedure

1. Install the Leak Test Fixture in the empty 1" pipe tee on the GREEN MACHINE.  
**See Figures 9-39, 9-40, and 9-41.**
2. The Leak Check is conducted with 1.0-PSI nitrogen.
3. Make sure the isolation valve on the Leak Test Fixture is fully closed.
4. Make sure the Leak Test Fixture pressure regulator is fully closed.
5. Make sure the nitrogen regulator is set to 2.0-PSI outlet pressure.
6. Slowly open the isolation valve on the Leak Test Fixture to provide pressure to the regulator.
7. Slowly open the Leak Test Fixture pressure regulator until the pressure gauge reads 1.0-PSI.

**CAUTION: PRESSURIZING THE GREEN MACHINE OVER A MAXIMUM OF 2.0 PSI MAY CAUSE DAMAGE TO THE GREEN MACHINE O-RINGS AND/OR PUMP SEALS, WHICH WILL VOID ALL WARRANTIES OF THE GREEN MACHINE.**

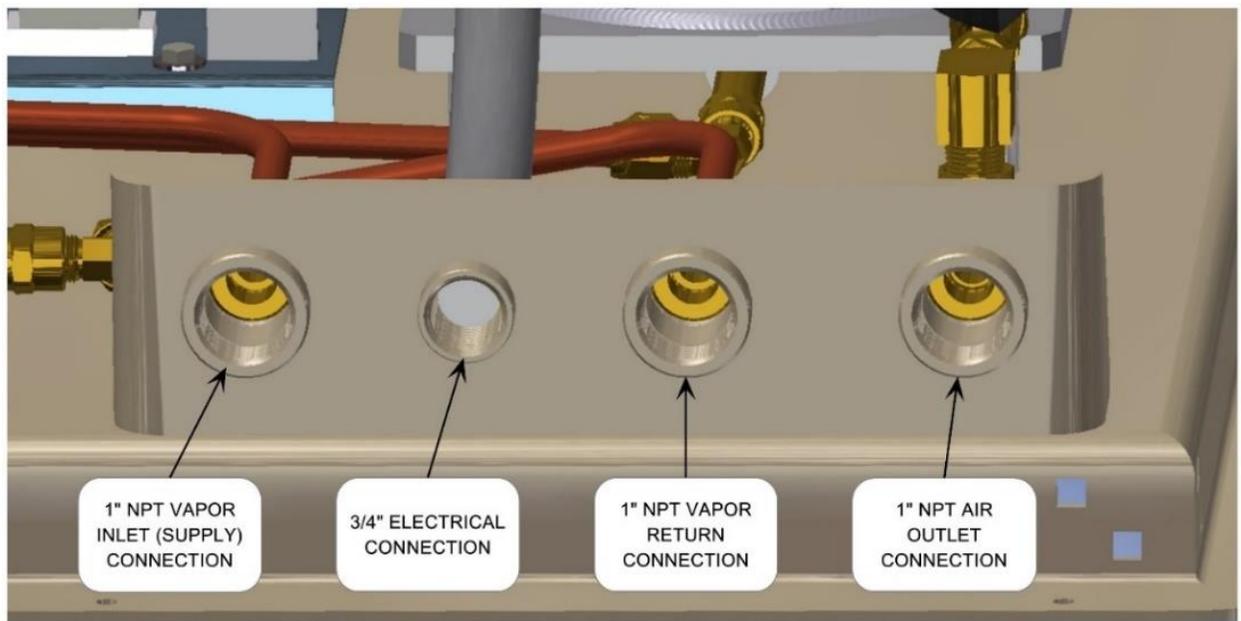
8. At the GREEN MACHINE Controller, press the F1 button to start the Leak Test, which will disable the Vacuum Pump and open all of the control valves.  
**See Figure 9-38.**
  - The Leak Test will continue until one of the following conditions is met:
    - The F4 button is pushed -OR-
    - The GREEN MACHINE Controller internal timer times out at 30 minutes.
9. With the GREEN MACHINE pressurized at 1.0-PSI nitrogen, spray a soapy solution on each fitting to check for bubbles:
  - If bubbles do not appear, the connection is tight.
  - If bubbles do appear, tighten the leaking fitting 1/8" turn (maximum) and re-check for leaks.
  - If the fitting cannot be tightened so that the connection is leak free, replace the 45° flare tube assembly that is leaking with a new tube assembly.
10. Continue this process until all the internal tube fittings have been checked and found leak free.
11. If additional time is needed to conduct the Leak Test, push the F1 button again to re-start the 30-minute timer.



Leak Test Procedure, continued...

12. After the Leak Test 30-minute timer expires and the test is complete:
  1. The GREEN MACHINE Controller will show the Maintenance Screen where the GREEN MACHINE is in the Manual OFF mode and will not operate.
  2. Remove the nitrogen from the Leak Test Fixture.
  3. Remove the Leak Test Fixture from the GREEN MACHINE.
  4. Re-install the cap in the tee.
  5. CAUTION: Make sure the 3-way valve below the Pressure Sensor is turned VERTICAL (ON or Open). Leaving the 3-way valve turned OFF (HORIZONTAL) will not allow the GREEN MACHINE to operate in the Normal Operating Mode.
  6. Put the cover back on the GREEN MACHINE and lock the hasps.
  7. Open the 3 ball valves at the GREEN MACHINE and place the locks on the valves.
  8. At the GREEN MACHINE Controller, push the ESC button to return to the Main Screen where the GREEN MACHINE will go into a Normal Operating Mode.

**CAUTION: DO NOT PUSH THE ESC BUTTON UNTIL THE BALL VALVES BETWEEN THE GREEN MACHINE AND THE VENT RISERS ARE OPENED. PUSHING THE ESC BUTTON WHEN THE VALVES ARE CLOSED WILL NOT ALLOW THE GREEN MACHINE TO OPERATE PROPERLY AND MAY CAUSE DAMAGE TO INTERNAL COMPONENTS.**



GM 4-PORT CONNECTIONS, 2/18/2016

Figure 9-39: GREEN MACHINE Vapor Inlet, Return, and Air Outlet Connections

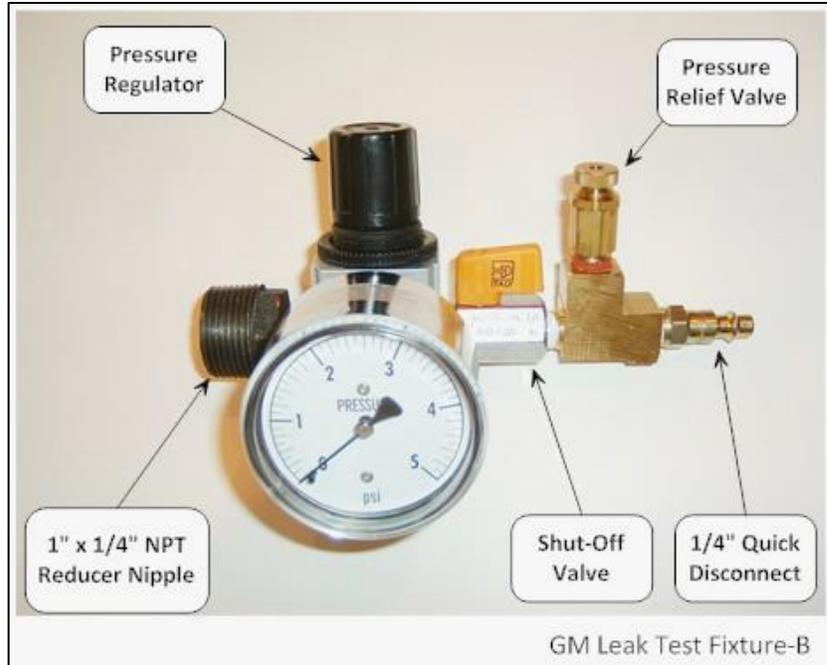
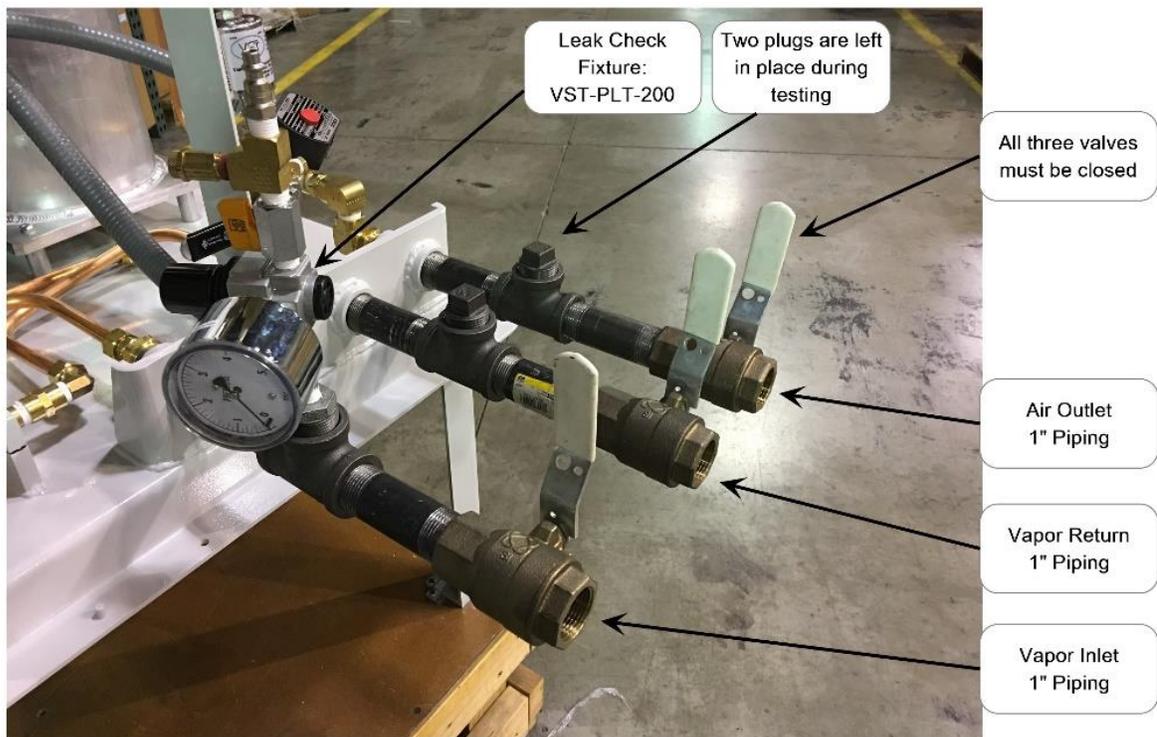


Figure 9-40: Leak Check Fixture



GM Leak Check Test Fixture-B, 11-2-2016

Figure 9-41: GREEN MACHINE with Vapor Inlet, Vapor Return, and Air Outlet



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# Chapter 10: Operator Instruction Sheet

## 10 Alarm Instructions

- See Figure 10-3 for the Alarm Screen.

### 10.1 Controller Screen

- If the Controller Screen is blank (no power):
  1. Make sure the GREEN MACHINE Breaker is turned on at the distribution panel.
  2. Make sure the Power Switch on the front of the Control Panel is turned ON.
  3. Make sure the Safety Disconnect Switch at the GREEN MACHINE is turned ON.
  4. Make sure the gasoline station ESO is not active.
    - If it is active, power will be OFF to the Control Panel.
    - When the ESO is de-activated, power will be restored to the VST Control Panel.
- If items 1-4 are true, and the Controller screen is still blank, call your GREEN MACHINE Authorized Service Contractor (ASC).

### 10.2 Pressure Sensor Alarm

- When a Pressure Alarm is active on the Controller:
  1. Call your GREEN MACHINE Authorized Service Contractor (ASC).

### 10.3 Vacuum Pump Alarm

- When a Vacuum Pump Alarm is active on the Controller:
  1. From the Main Screen (**See Figure 10-1**) push the Maintenance soft button on the PLC screen.
  2. Enter 878 on the Password Screen (**See Figure 10-4**), then push the Return button on the right-hand side of the screen.
  3. ON the Maintenance Screen (**See Figure 10-2**), the “Reset Motor Alarm” button will be RED. Push the “Reset Motor Alarm” button to reset the Vacuum Pump Motor alarm.
  4. IF THE VACUUM PUMP ALARM CONTINUES TO ALARM ON THREE CONSECUTIVE DAYS, call your GREEN MACHINE Authorized Service Contractor (ASC).



## 10.4 Maintenance Switch Alarm

- When a Maintenance Switch Alarm is active on the Controller:
  1. Maintenance Switch on the front of the Control Panel cover is turned OFF.
  2. Turn the Maintenance Switch to turn ON.
  3. After the Maintenance Switch is turned ON, the Maintenance Switch Alarm will clear and the GREEN MACHINE can operate.
  4. If the Maintenance Switch Alarm does not clear after it is turned ON, call your GREEN MACHINE Authorized Service Contractor (ASC).

## 10.5 Overfill Alarm

- When an Overfill is active on the Controller:
  1. An Overfill has occurred at the station during a fuel drop.
  2. The Overfill Alarm should clear 2-hours after the overfill clears. Check the Fuel Management System to see if there is a UST overfill.
  3. If the Overfill Alarm has not cleared in 24-hours, call your GREEN MACHINE Authorized Service Contractor (ASC).

## 10.6 SD Card Alarm

- The GREEN MACHINE will continue to operate if there is a SD Card Alarm.
- When the SD Card Alarm is active on the Controller:
  1. An SD Card is not installed in the Controller slot.
  2. The SD Card write protection is ON.
  3. When the SD Card is not inserted into the slot properly.

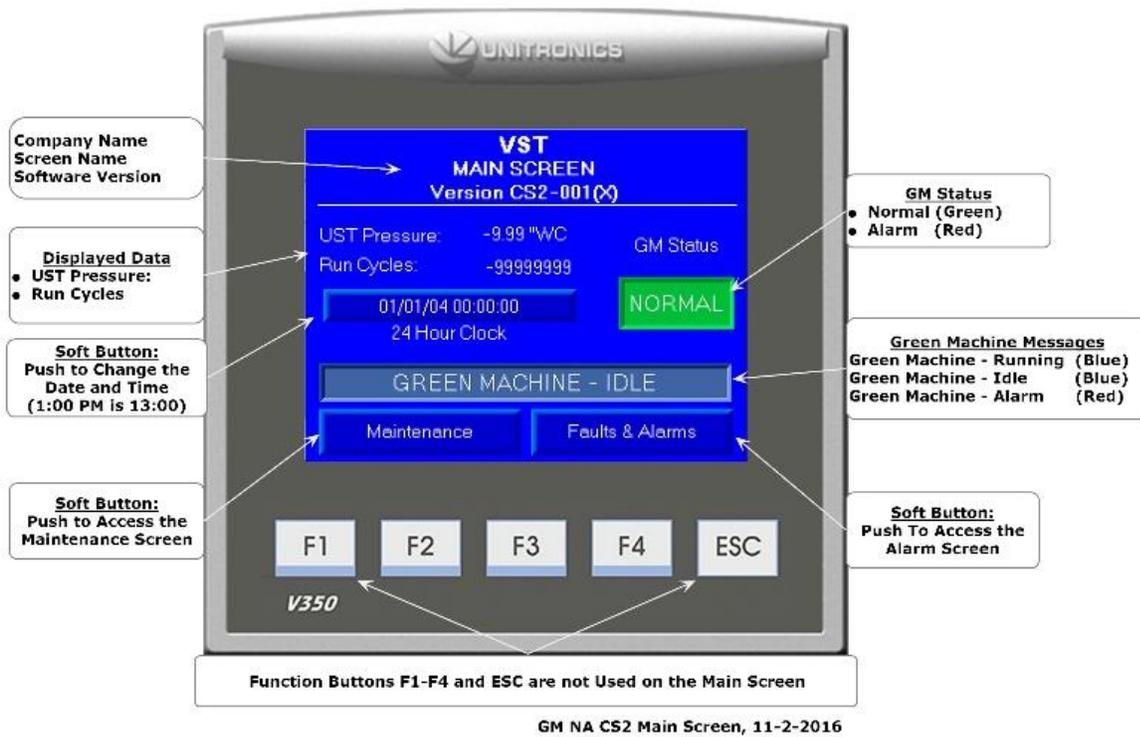


Figure 10-1: Main Screen

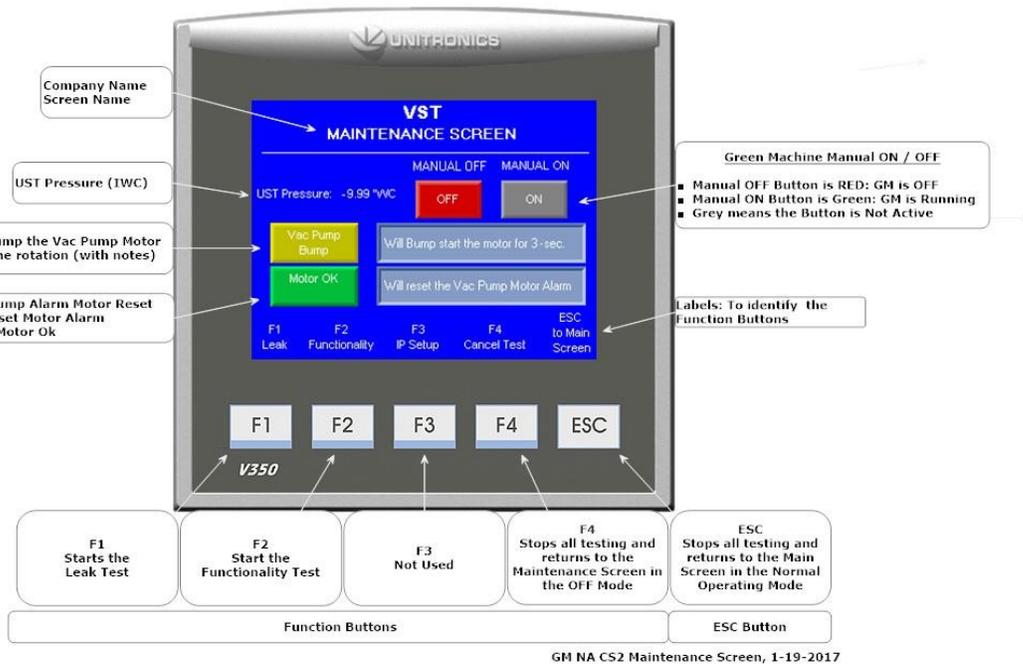


Figure 10-2: Maintenance Screen

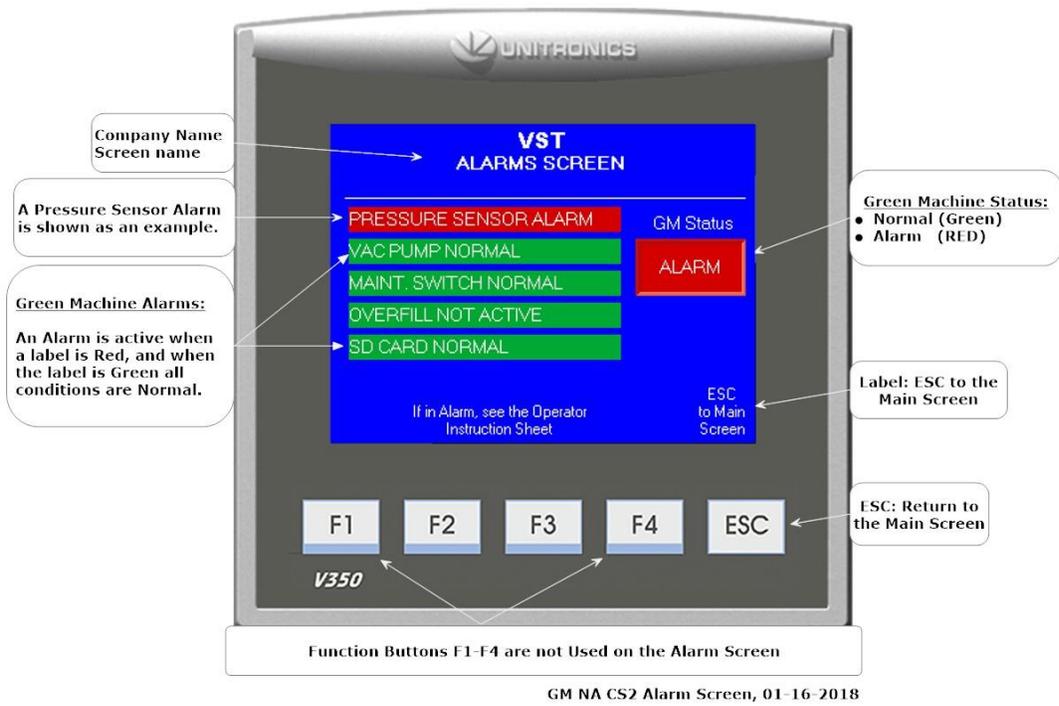


Figure 10-3: Faults & Alarm Screen

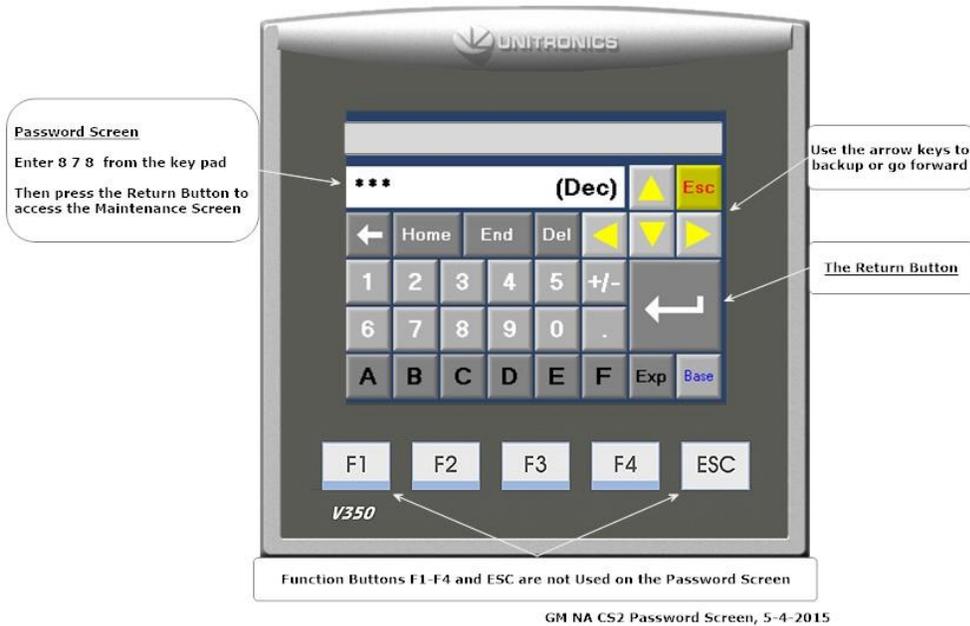


Figure 10-4: Password Screen

Push ESC to return to the Main Screen when in the Maintenance, Faults & Alarms, or Password Screens.



## 10.7 How to Remove and Insert the SD Card into Unitronics PLC Slot



**Figure 10-5: Inserting and Removing the SD Card from the PLC**

- **See Figure 10-5** above shows how the SD Card is inserted into the PLC. Please note the orientation of the SD Card.
- To install, place the SD Card into the PLC slot, note the orientation of the SD Card.
  - **CAUTION:** Once the SD Card is partially inserted in the PLC slot, use your finger nail, not a hard tool, to fully insert the SD Card into PLC slot.
- To remove the SD Card from the PLC slot:
  - The SD Card can be removed from the PLC by using your finger nail and pressing the SD Card in, releasing it and then pulling the SD Card out of the slot in the PLC.



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# Chapter 11: GM Operator Training Guide

## 11 About VST



Vapor Systems Technologies, Inc. began in 1990 with the vision of **One Company – One Integrated Solution.**

Today, that philosophy is still in place and getting stronger. Recognizing that a healthier environment is a need and not an option, VST has dedicated its undivided attention to the ever-changing, stringent regulations that govern fugitive vapors at gasoline dispensing facilities (GDF). To this challenge, VST is committed to a continual R&D campaign of developing the most current, technologically advanced solutions to service not only the United States, but also the world.

VST specializes in the development, engineering, and manufacturing of products that are sold into the GDF segment of the petroleum industry. The VST focus provides our customers and users with exceptional products, services, and innovative solutions for improving the fueling-station experience as well as the world's air quality.

VST's product offering includes curb pump and vapor recovery hoses, safety breakaways, nozzles, and emission-control system - GREEN MACHINE. The ENVIRO-LOC™ vapor-recovery product offering represents the most innovative concept in the industry for trapping fugitive vapors from the front end (vehicle refueling) to the back end (vent risers) of the GDF site.

### 11.1 GREEN MACHINE Theory of Operations

- The VST GREEN MACHINE operates based on monitoring the Underground Storage Tank (UST) system pressure.
- The GREEN MACHINE controller provides UST pressure data via a Pressure Sensor, located in the GREEN MACHINE, and manages the GREEN MACHINE operation.
- The pressure data is provided to the VST Control Panel for system monitoring functions.
- The closed loop vapor piping solution continuously operates the system to control UST pressure below 0.2 IWC.
- **See Figure 11-1** for an overview layout of where a GREEN MACHINE is located and operates in a gasoline station.

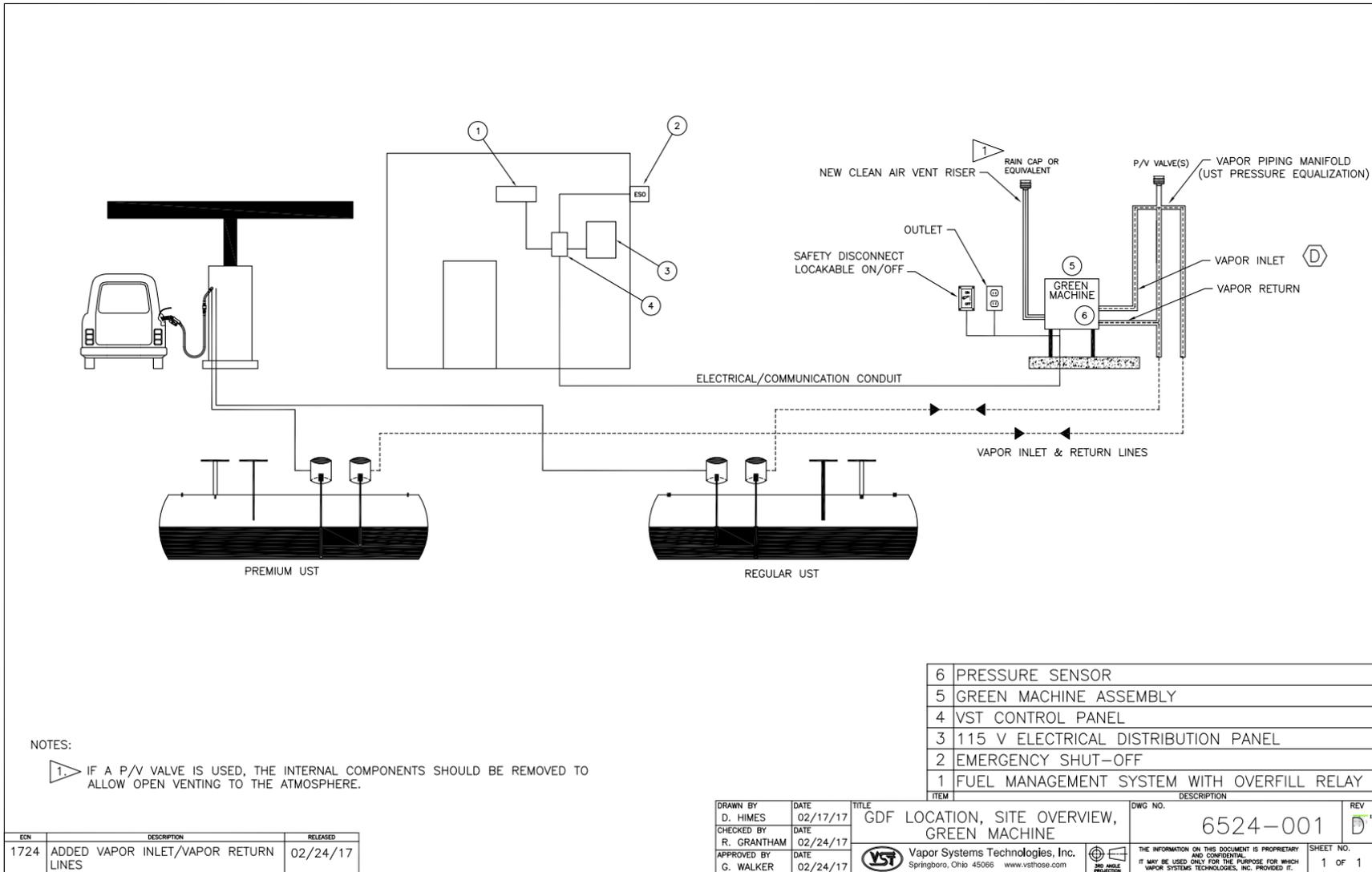


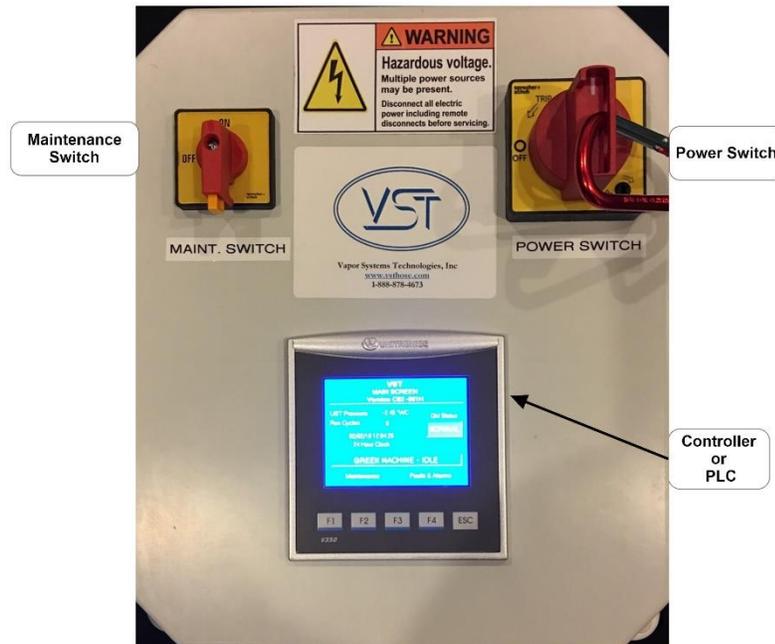
Figure 11-1: GREEN MACHINE Gasoline Station Overview



## 11.2 VST Control Panel

### 11.2.1 VST Control Panel Overview

- The VST Control Panel is designed to manage the operations of the GREEN MACHINE based on UST vapor pressure. **Figure 11-2** shows the front of the Control Panel with the following items:
  - GREEN MACHINE Controller.
  - Controls the GREEN MACHINE based on UST vapor pressure.
- Power Switch:
  - Provides a means to disconnect ALL power from the Control Panel and ALL power to the GREEN MACHINE.
  - Can be locked in the OPEN or CLOSED position. (Use lockout/tagout procedures.)
- Maintenance Switch:
  - Turning OFF the Maintenance Switch will remove ALL power from the GREEN MACHINE.
  - Turning OFF the Maintenance Switch will keep power ON to the GREEN MACHINE Controller for Testing and/or Maintenance.



NA GM CS2 Control Panel, 04-24-2018

Figure 11-2: VST Control Panel



## 11.2.2 Main Screen

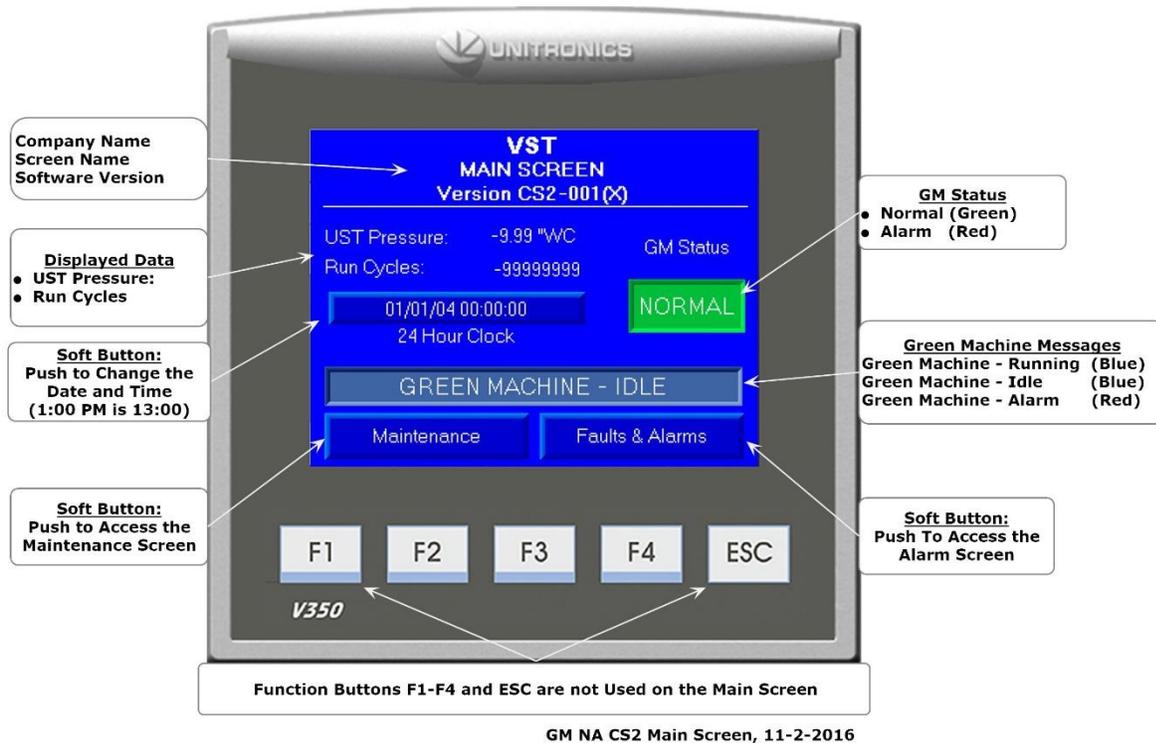


Figure 11-3: Main Screen

- The Control Panel PLC will always power up in the Main Screen. **See Figure 11-3.**
- The GREEN MACHINE will always be in the Normal Operating mode when the Main Screen is showing on the PLC, unless there is an Alarm Condition.
- **GM Status:**
  - Normal (Green Box) indicates the GREEN MACHINE is operating normally (no active Alarms).
  - Alarm (Red Box) indicates an Alarm is active.
  - When an Alarm is active, see the Operator Instruction Sheet for directions.
- **Date and Time:**
  - Push the Date and Time soft button to change the Date and Time.
- **Maintenance Screen and an Alarm Screen:**
  - Push the Maintenance Screen soft button to access the Maintenance Screen.
    - A password 878 is required to access the Maintenance.
  - Push the Alarm Screen soft button to access the Alarm Screen.



GREEN MACHINE Messages, continued...

- **GREEN MACHINE Messages:**
  - GREEN MACHINE – Running  
Due to the UST pressure being greater than 0.2 IWC  
(Blue Text Box)
  - GREEN MACHINE – Idle  
Due to the UST pressure being less than 0.2 IWC  
(Green Text Box)
  - GREEN MACHINE – Alarm  
Go to the Alarm Screen to identify the Alarm: An Alarm has activated.  
(Red Text Box)  
See the Operator Instruction Sheet for directions.
- **Displayed Data:**
  - UST Pressure (IWC):  
Displays the UST pressure in real-time.
  - Run Cycles:  
Displays the number of GREEN MACHINE completed cycles.
  - Date and Time Date (MM/DD/YY) and 24-Hour Clock (HH:MM:SS)

11.2.3 Maintenance Screen

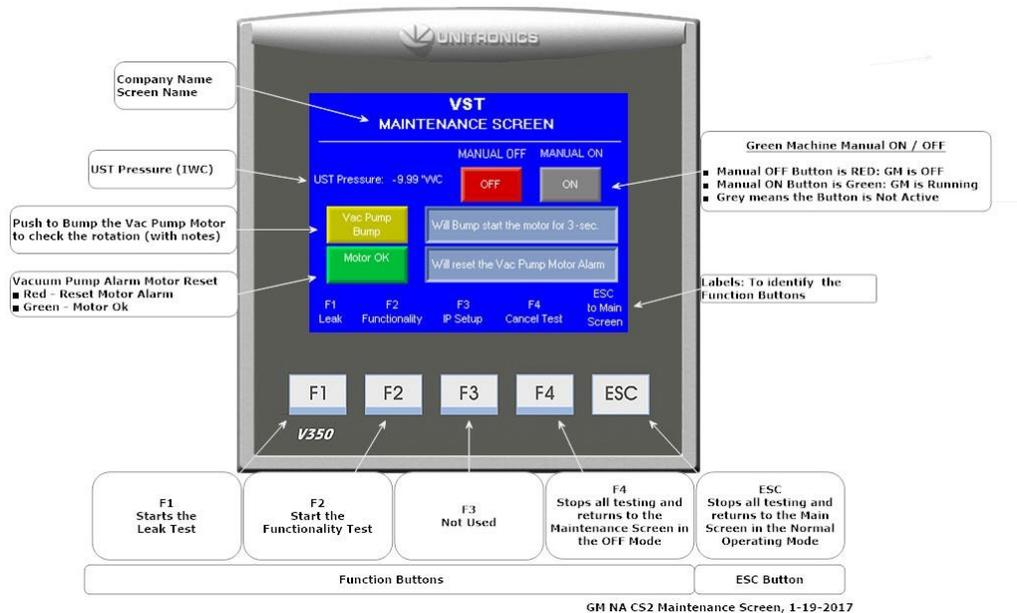


Figure 11-4: Maintenance Screen



Maintenance Screen, continued...

- When the Maintenance Screen is shown, the GREEN MACHINE will always be in the OFF mode (unless the Manual ON button is pushed). **See Figure 11-4.**
- The UST Pressure is displayed as Inches of Water (IWC).
- The GREEN MACHINE can be placed in the Manual ON or Manual OFF mode only in the Maintenance Screen.
  - This feature is used when conducting maintenance on the GREEN MACHINE.
- Vac Pump Bump is used to check the Vacuum Pump motor rotation during start-up or after performing maintenance on the Vacuum Pump motor.
- The Reset Motor Alarm is used when the Vacuum Pump is in Alarm.
- Function Button labels are shown at the bottom of the screen.
- The F1, F2, F3, F4 Function buttons and the ESC button are accessible.
  - F1 Start a Leak Test
  - F2 Start a Functionality Test
  - F3 Not Used
  - F4 Stops all testing and returns to the Maintenance Screen in the OFF Mode.
- Pushing the ESC button stops all testing and returns to the Main Screen to the Normal Operating Mode.



## 11.2.4 Alarm Screen

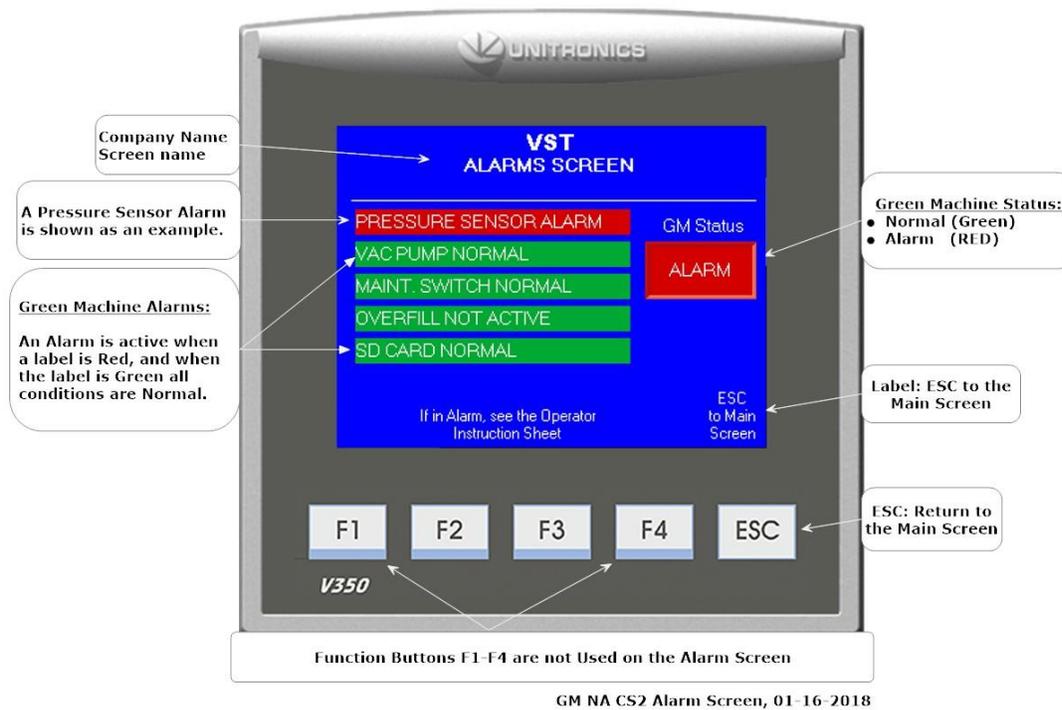


Figure 11-5: Pressure Sensor Alarm shown on the Faults & Alarms Screen

## 11.3 Alarms Overview

- The Alarms Screen shows the following alarms: **See Figure 11-5.**

### 11.3.1 GM Status

- Normal (Green Box) indicates the GREEN MACHINE is operating normally (no active Alarms)
- Alarm (Red Box) indicates an Alarm is active. When an Alarm is active, See the Operator Instruction Sheet for directions.

### 11.3.2 Pressure Sensor Alarm

- The fault will occur if the Pressure Sensor is not connected to the VST Control Panel or is wired incorrectly at the VST Control Panel or the Pressure Sensor fails.
- The GREEN MACHINE will not to operate during this alarm.



### 11.3.3 Vacuum Pump Alarm

- The VST controller will indicate an alarm for the following items:
  - The Vacuum Pump breaker has tripped
  - Main voltage is too low
  - Output short circuit
  - Motor overload
  - Motor temperature is too high
  - The Vacuum Pump is not working properly
  - The GREEN MACHINE will not to operate during this alarm

### 11.3.4 Maintenance Switch Alarm

- When the Maintenance Switch is engaged the GREEN MACHINE will not operate and a Maintenance Switch Alarm will show as active.
- To remove the Maintenance Switch Alarm, turn the Maintenance Switch ON to disengage the Maintenance Switch.
- The GREEN MACHINE will not to operate during this alarm.

### 11.3.5 Overfill Alarm

- An overfill condition exists when, during a fuel drop, the gasoline level in the UST exceeds the Overfill Alarm setting, which is 90% capacity of the UST.
  - The VST Control Panel is connected to the Tank Overfill Alarm output relay.
  - When an overfill occurs, the output (N.O.) relay closes and GREEN MACHINE will turn OFF.
  - The Overfill Alarm box will display RED indicating an Overfill Alarm is active.
  - When the gasoline level drops below the Overfill Alarm level, the output relay opens and the alarm clears, the GREEN MACHINE will remain OFF for 2 additional hours.
  - After the 2-hours elapse:
    - The Overfill Alarm box will clear.
    - The GREEN MACHINE will turn ON if the UST pressure is above 0.2 IWC.
    - The GREEN MACHINE will remain OFF if the UST pressure is below 0.2 IWC.

Overfill Alarm, continued...



- An overfill might happen if the delivery person fails to stop fueling, ignoring both the overfill limit and the high-product limit.
  - VST has determined that overfill protection is needed to reduce the chance of gasoline entering the GREEN MACHINE.
- Below are the precautionary measures taken to protect the GREEN MACHINE against an overfill situation:
  - The VST Control Panel will disable the GREEN MACHINE when the UST level reaches the OVERFILL Alarm setting (OVERFILL LIMIT: 90%) when the relay contacts close at the Fuel Management System.
  - Eventually, as fuel is dispensed, the product would drop below the OVERFILL Alarm threshold thereby resetting the relay and re-enabling the GREEN MACHINE.
  - The Fuel Management System OVERFILL Alarm will not guarantee that the GREEN MACHINE is protected from gasoline entering into it.
  - The GREEN MACHINE will not operate during this alarm.

#### 11.3.6 SD Card Alarm

- The GREEN MACHINE will operate when there is a SD Card Alarm.
- The SD Card Alarm will activate when the following items occur:
  - An SD Card is not installed in the PLC.
  - The SD Card write protection is ON.
  - When the SD Card is not inserted in to the slot properly.
  - The card cannot record the data while there is an SD Card Alarm.
- After the Card is installed, the fault will clear and Alarm will show Green.
- The GREEN MACHINE will operate during this alarm.



### 11.3.6.1 How to Insert and Remove the SD Card into Unitronics PLC Slot



Figure 11-6: Inserting and Removing the SD Card from the PLC

- **See Figure 11-6** shows how the SD Card is inserted into the PLC. Please note the orientation of the SD Card.
- To install, place the SD Card into the PLC slot, note the orientation of the SD Card.
  - **CAUTION:** Once the SD Card is partially inserted in the PLC slot, use your finger nail, not a hard tool, to fully insert the SD Card into PLC slot.
- To remove the SD Card from the PLC slot:
  - The SD Card can be removed from the PLC by using your finger nail and pressing the SD Card in, releasing it and then pulling the SD Card out of the slot in the PLC.



## 11.4 Station UST Environmental Compliance Testing and Services

- When a UST Environmental Compliance Testing and Service company conducts their testing, it is usually for compliance or company regulations. The testing usually has to do with underground storage tanks, piping, dispensers, or a combination of the three. There are several test that may be conducted (if applicable).
- Any time a test is being conducted, the GREEN MACHINE MUST BE TURNED OFF to ensure the GREEN MACHINE does not operate.
- Before Testing Begins:
  1. At the front of the VST Control Panel, remove the carabiner clip and turn OFF the Power Switch. Reinstall the carabiner clip after power is turned OFF by pushing in the “handle slide” then installing the clip. This will turn OFF all power to the VST Control Panel and to the GREEN MACHINE. The PLC will not show any screens and will be blank
  2. There is no need to close the isolation valves at the GREEN MACHINE since powering off the VST Control Panel will close the control valves inside the GREEN MACHINE. This will isolate the GREEN MACHINE from the UST, the vent risers, and all external vapor piping.
- After Testing is Complete:
  1. Remove the carabiner clip and turn the Power Switch to ON. Next install the carabiner clip by pushing the “handle slide” in, then installing the clip.
  2. The PLC will boot up in the Main Screen and will be in a Normal Operating Mode.

## 11.5 Locks and Keys

- VST has provided keys with the GREEN MACHINE, specifically for the following:
  - 3-Locks - Locking Ball Valves on the Vapor Inlet, Vapor Return and on the Air Outlet
  - 2-Locks – For the Cover
  - 1-Lock – For the Power Switch at the GREEN MACHINE.
- All the locks are keyed the same.
  1. When the GREEN MACHINE is operational, the ball valves must remain locked in the open position to prevent damaging the GREEN MACHINE.



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# Appendix A - General Contractor Check-Out Form

The final step in the installation process is to start up the GREEN MACHINE and get it field commission ready.

Before this process can be started, the GREEN MACHINE must be completely and correctly installed, which is why Appendix A was developed.

## How to Submit Appendix A:

1. Go to [www.vsthose.com](http://www.vsthose.com)
2. Click on VST Education & Training (at the bottom of the page)
3. Under “US GREEN MACHINE™”  
Click on “Supporting Documents & Instructional Videos”
4. Under “General Contractor”  
Click on “Appendix A – General Contractor Check-Out Form”
5. Fill out Appendix A, then click on Submit at the bottom of the form
6. Receive an email from VST with a copy of the filled out Appendix A

The following pages contain the contents of Appendix A and the questions you’ll be asked. You may find it helpful to review these pages, so you’re prepared for the online questions and requirements.

**Once filled out, Appendix A must be submitted by the General Contractor on-line to insure the GREEN MACHINE is ready for Start-Up.**



# Appendix A – General Contractor Check-Out Form

## To be filled out by the General Contractor

Site Information:			
Site Name:			
Site ID:			
Site Street Address:	Site City:	Site State:	Site Zip:

Contractor Information:	
<b>General Contractor (GC) Company:</b>	
GC Phone:	
GC Name:	
GC Email Address:	
GC VST Contractor Cert. #	
Date of Completion:	
GREEN MACHINE Serial Number (SN):	
*the SN can be found on the back side of the junction box inside the GM cover & out the outside of the cover	

Sub- Contractor Information:	
<b>Electrical Contractor (EC) Company:</b>	
EC Name:	
EC VST Contractor Cert. #	
<b>Vapor Piping Contractor (VPC) Company:</b>	
VPC Name:	
VPC VST Contractor Cert. #	

## **IMPORTANT!!**

VST highly recommends going through this check-out form with both the Electrical Contractor and Vapor Piping Contractor so that all steps can be verified to be complete.



STEPS	DESCRIPTION	CHECK AFTER COMPLETION	RESULTS
	<b>Reference Chapter 2 for the Piping Installation:</b>	~	~
1.	Check that all the piping, valves, tees, unions, and riser are installed as shown in <b>Chapter 2, Piping</b>		PIPING IS COMPLETE
2.	Make sure the three valves located at the GREEN MACHINE are locked in the Open position.		ISOLATION VALVES ARE LOCKED OPEN
3.	Make sure the piping connected to the GREEN MACHINE slopes a minimum of ¼" per foot towards the vent risers, and that there are no traps.		PIPING SLOPE AND TRAPS
4.	Make sure the ¼" drain line is installed correctly between the vapor inlet and vapor return.		¼" DRAIN LINE IS INSTALLED
	<b>Reference Chapter 3 for the Electrical Installation:</b>	~	~
5.	Check that all the electrical connections are complete, correct, and tight at the VST Control Panel and at the GREEN MACHINE Internal Junction Box.		ELECTRICAL IS COMPLETE
6.	Turn OFF the Maintenance Switch on the front of the VST Control Panel. The Maintenance Switch Alarm will be active when power is turned ON. (When power is applied to the Control Panel, the GREEN MACHINE cannot operate with the Maintenance Switch OFF regardless of UST pressure.)		MAINTENANCE SWITCH IS TURNED OFF
7.	Turn the GREEN MACHINE breaker ON at the Main Distribution Panel.		MAIN POWER IS ON
8.	Check that the VST Control Panel wiring is connected to the station Emergency Shut-OFF (ESO) switch.		ESO IS CHECKED
9.	Check that the VST Control Panel wiring is connected to the TLS-350 or TLS-450 Overfill Alarm.		OVERFILL IS CHECKED
10.	Check that the Power Switch at the GREEN MACHINE is installed and working, and is turned ON.		SAFETY SWITCH IS CHECKED
11.	Turn OFF power at the VST Control Panel at the Power Switch on the front of the Control Panel and lock the switch OFF with the carabiner clip.		CONTROL PANEL IS OFF

All items have been checked and verified:

\_\_\_\_\_ Name

\_\_\_\_\_ Date

**POST-INSTALLATION GREEN MACHINE™ CHECK-OUT:**

- Upon completion, the General Contractor must submit this signed and dated form on-line to VST.
- After the form is complete, Click the Submit button at the end of the form.



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## Appendix B - Start-Up Contractor Check-Out Form

The final step in the installation process is to start up the GREEN MACHINE and get it field commission ready.

This final commissioning process requires a verification code that will be entered into the PLC.

### How to Submit Appendix B and get a Verification CODE:

1. Go to [www.vsthose.com](http://www.vsthose.com).
2. Click on VST Education & Training (at the bottom of the page)
3. Under "US GREEN MACHINE™"  
Click on "Supporting Documents and Instructional Videos."
4. Click on "Start-Up / Commissioning Contractor."  
Note: If you have not been trained to conduct Appendix B, Click on "Appendix B – Training Video," then go to Step 5.
5. Click on "Appendix B - Start-Up Contractor Check Out Form."
6. Fill out Appendix B with the required photos, then click on Submit at the bottom of the form.
7. Receive an email from VST with the verification code and a copy of the filled-out Appendix B.

The following pages contain the contents of Appendix B and the questions you'll be asked. You may find it helpful to review these pages, so you're prepared for the online questions and requirements.

### **Appendix B must be used with Chapter 6: Testing & Start-Up Procedures.**

**Once filled out, Appendix B must be submitted by the Start-Up Contractor on-line to ensure the GREEN MACHINE becomes operational.**



# Appendix B - Start-Up Contractor Check-Out Form

**To be filled out by the Start-Up Contractor**

## SITE INFORMATION:

Site: \* \_\_\_\_\_

Site ID: \_\_\_\_\_

Site Address: \_\_\_\_\_

Station Phone: \_\_\_\_\_

## START-UP CONTRACTOR INFORMATION:

Start-Up Contractor Company: \* \_\_\_\_\_

Start-Up Contractor Phone: \* \_\_\_\_\_

Start-Up Contractor's Name: \* \_\_\_\_\_

Start-Up Contractor's VST  
Certification Number: \* \_\_\_\_\_

Email Address: \* \_\_\_\_\_

**NOTE:** This is the e-mail address that the Start-Up Validation CODE will be sent. Make sure you have immediate access to your e-mail listed above to complete the Start-Up. If the CODE cannot be received, the GREEN MACHINE CAN NOT become operational.

Start-Up Date of Completion: \* \_\_\_\_\_

GREEN MACHINE  
Serial Number: \* \_\_\_\_\_

The Serial Number (SN) can be found on the back side of the junction box  
**Note:** inside the GREEN MACHINE cover, and on the outside of the cover.



The following readings must be filled out. This information is to make sure the VST Control Panel is reading the correct information and that the underground storage tanks are below the Overfill Alarm Level of 90%.

<b>Record the Reading from the PLC:</b>	
UST Pressure Reading (IWC):	
Run-Cycles Reading (No.):	

<b>Underground Storage Tanks Levels Readings and Calculations</b>	
If a UST tank level exceeds 90%, and the Overfill Alarm is installed, the GREEN MACHINE will not operate. The tank information entered below will calculate the tank levels (%). Obtain and fill in the volumes and ullages from the Fuel Management System in order to calculate the tank levels.	
Tank 1 Volume (Gal.) *	
Tank 1 Ullage (Gal.) *	
<b>Tank 1 Level (%) Calculated</b>	
Tank 2 Volume (Gal.) *	
Tank 2 Ullage (Gal.) *	
<b>Tank 2 Level (%) Calculated</b>	
Tank 3 Volume (Gal.) *	
Tank 3 Ullage (Gal.) *	
<b>Tank 3 Level (%) Calculated</b>	
Tank Other Volume (Gal.) *	
Tank Other Ullage (Gal.) *	
<b>Tank Other Level (%) Calculated</b>	



STEPS	DESCRIPTION	CHECK AFTER COMPETION	RESULTS
1.	<ul style="list-style-type: none"><li>Bump Test</li></ul>		STARTUP & TESTING
2.	<ul style="list-style-type: none"><li>Functionality Test</li></ul>		
3.	<ul style="list-style-type: none"><li>Check the TLS-350 or TLS-450 Overfill Alarm Connection Test</li></ul>		
4.	<ul style="list-style-type: none"><li>Change the Date and Time Procedure</li></ul>		
5.	All 3 plugs are installed in the 3 tees at the GREEN MACHINE.		INSTALL THE TEE PLUGS
6.	Make sure the 3 ball valves at the GREEN MACHINE are locked in the OPEN position.		OPEN THE ISOLATION VALVES
7.	With the cover removed, the 3-way valve below the Pressure Sensor must be turned in the VERTICAL (ON or Open). Leaving the 3-way valve turned HORIZONTAL (Closed or OFF) at the Pressure Sensor will not allow the GREEN MACHINE to operate in the Normal Operating Mode.		OPEN THE PRESSURE SENSOR VALVE
8.	Place the cover on the GREEN MACHINE and lock the hasp on the cover.		INSTALL THE COVER
9.	Turn the Maintenance Switch on the front of the VST Control Panel to ON.		MAINT. SWITCH IS ON
10.	At the Main Screen, push the Alarms Screen to make sure there are no active alarms and all the Alarm boxes are Normal (Green). Push the ESC button to return to the Main Screen. If there is an Alarm, see the Operator Instruction Sheet for directions.		CHECK THE ALARMS



## GREEN MACHINE Start-Up Form, continued...

STEPS	DESCRIPTION	CHECK AFTER COMPETION	ITEM CHECKED
11.	Below are the required pictures to be submitted with Appendix B:		
11.1	Picture of the entire vent riser.		Pictures to Up-Load
11.2	Picture of the vapor piping at the GREEN MACHINE showing the ¼" diameter copper drain line.		
11.3	Picture of the valves locked in the open position.		
11.4	Picture of the VST Control Panel PLC Main Screen.		
11.5	Picture inside the VST Control Panel, inside the front door.		
11.6	Picture inside the VST Control Panel, inside the panel.		
11.7	Picture inside the VST Control Panel, showing the field wiring connections.		
<b>CAUTION: The locking ball valve handles at the GREEN MACHINE inlet, return, and outlet must <u>not</u> be removed.</b>			

All items have been checked and verified:

\_\_\_\_\_  
Name (Print)

\_\_\_\_\_  
Date

**GREEN MACHINE START-UP CHECK-OUT:**

- Upon completion, the Start-Up Contractor must submit this signed and dated form on-line to VST.
- After the form is complete, Click the Submit button at the end of the form.